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PHYTOCOENOLOGIC STUDY CONCERNING THE ACIDOPHILOUS GRASSLANDS OF CODRU-MOMA MOUNTAINS (NORTH-WEST OF ROMANIA)

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Abstract

In the present study the acidophilous grassland vegetation of Codru-Moma Mountains is described and analyzed in phytocoenologic terms. The research of acidophilous grasslands from Codru-Moma Mountains was carried out in 2010-2011.

In this work two acidophilous phytocoenological associations were studied and analyzed, namely: Nardo-Festucetum rubrae fallax association Puşcaru et al. 1959 and Festuco-Genistelletum association Issler 1927.

The two acidophilous associations identified in Codru-Moma Mountains were analyzed in terms of life forms, floristic elements and ecological indices.

Key words: grassland, acidophilous, association, floristic elements, life forms, ecological indices.

INTRODUCTION

Codru-Moma Mountains are geographically located in the western part of Apuseni Mountains, with an orientation to NV-SE.

The varied configuration of the Codru-Moma Mountains relief reflects the geological complexity of the substrate, thus the crystalline foundation is covered by volcanic and sedimentary formations. The main types of soils fall in the cambic soil class, biggest share having the brown and brown acid soils.

Vegetation is diverse, the largest share having the forests (81%), followed by glades, pastures and meadows (10%), and arable land occupies an area of 9%.

MATERIAL AND METHODS

In the study of acidofile grassland from Codru-Moma Mountains phytocoenological research methods were used in the spirit of the Central European school, based on principles and methodology developed by J. Braun-Blanquet (Braun-Blanquet 1928).

The drawing up of synthetic tables was performed by using the methodology suggested by Cristea V. (Cristea et al., 2004). For the description and classification of associations the synthetic work on Romania vegetation and flora developed in recent years was used (Sanda et al. 1983;

Ciocârlan, 2000; Mihăilescu, 2001; Sanda, 2002; Sanda et al. 2007; Groza, 2008; Sanda et al., 2008).

The synthetic tables of the two associations studied contain information about species that are included in the floristic composition of the associations (life form, floristic element, ecological indices) and in terms of relevées performed: serial number of relevée, vegetation cover, altitude, exposition, slope, area, place and date of relevée.

RESULTS AND DISCUSSION

Acidophilous grasslands studied in Codru-Moma Mountains are classified in coenotaxonomical terms as follows:

Nardo-Callunetea class Preising 1949
Nardetalia order Oberdorfer 1949
Potentillo-Nardion alliance Simon 1959
Nardo-Festucetum rubrae fallax association Puşcaru et al. 1959
Genistion pillosae alliance Duvigneaud 1942
Festuco-Genistelletum association Issler 1927

Acidophilous grasslands of *Festuca rubra* with *Nardus stricta* grow mainly on southern and western slopes, but also on the northern slopes in sheltered places. *Nardo-Festucetum rubrae fallax* association Puşcaru et al. 1959 is found on brown acid, fallow, moderately acidic soils and with middle trophicity. In these phytocoenoses besides revealing species (*Festuca rubra* and *Nardus stricta*) a number of species characteristic for alliance, order and class occur with high frequency, namely: *Genistella sagittalis*, *Hypericum maculatum*, *Danthonia decumbens*, *Hieracium pilosella*, *Luzula campestris*, *Potentilla erecta*, *Viola canina* (Table 1).

Festuco-Genistelletum association Issler 1927, grows in succession of *Festuca rubra* with *Nardus stricta* grassland,which is a process determined by the degradation of the soil and the forming of a dry climate. In these phytocoenoses xeromezophyles species occur in large numbers (*Brachypodium pinnatum*, *Genista tinctoria*, *Trifolium montanum*, *Silene nutans*, *Dianthus carthusianorum*) as acidophilous species (*Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Hieracium umbellatum*, *Hieracium pilosella*, *Potentilla erecta*) (Table 2). As soil acidification grows, the phytocoenoses belonging to the *Festuco-Genistelletum* association Issler 1927, evolve to installing the *Nardus stricta* phytocoenoses, small in grazing terms.

Coenotaxonomically in the phytocoenoses of the two associations studied one can see that there is a number of species characteristic to *Molinio-Arrhenatheretea* class and *Festuco-Brometea* class, which shows that the evolution of these phytocoenoses takes as its starting point the two classes.

Table 1

Nardo-Festucetum rubrae fallax association Puşcaru et al. 1959

L.f.	F.e.	U.	T.	R.	Number	1	2	3	4	5	6	7	8	9	K
					Altitude (m.s.m.)	680	700	710	800	800	700	650	630	600	
					Vegetation cover (%)	100	100	100	100	100	100	100	100	100	
					Exposition	-	S	V	V	N	N	S	SV	SV	
					Slope (º)	-	5	5	5	25	5	20	5	10	
					Area (m²)	100	100	100	100	100	100	100	100	100	
H	Cp(bor)	3	0	0	As. *Festuca rubra*	1	1	+	2	1	4	+	3	1	V
H	E	0	0	1.5	As. *Nardus stricta*	4	4	5	4	3	1	5	2	4	V
					Potentillo-Nardion, Nardetalia										
H-Ch	Cp(bor)	3	1	2.5	*Antennaria dioica*	·	·	·	·	·	+	·	·	·	I
H	Cp(bor)	3.5	3	3	*Carex pallescens*	+	·	+	·	·	·	+	·	·	II
H	Atl-M-Ec	3	3	3	*Genistella sagittalis*	1	1	+	·	·	·	·	1	·	III
H	Eua	4	3	2	*Hypericum maculatum*	+	+	·	+	+	+	+	·	+	IV
H	Eua	3	3	3	*Polygala vulgaris*	+	·	·	·	·	·	·	+	·	II
					Nardo-Callunetea										
H	Eua(bor)	4	2.5	3	*Carex ovalis*	·	·	·	·	·	·	·	+	·	I
H	E	0	3	2	*Danthonia decumbens*	+	+	+	+	·	+	·	·	+	IV
H	E	2.5	0	0	*Hieracium pilosella*	·	+	+	·	·	+	·	+	·	III
H	Cp(bor)	2.5	3	2.5	*Hieracium umbellatum*	+	·	·	·	·	·	·	·	·	I
H	E	3	0	3	*Luzula campestris*	+	+	+	+	·	+	+	·	·	IV
Ch	Cosm	3	3	1	*Lycopodium clavatum*	·	·	·	·	+	·	·	·	·	I
H	Eua	0	0	0	*Potentilla erecta*	+	1	+	+	1	·	+	+	+	V
Ch	Eua	2	2	2	*Veronica officinalis*	+	+	·	+	·	+	+	·	·	III
H	Eua	2.5	3	2	*Viola canina*	1	+	·	·	·	+	+	·	1	III
					Molinio-Arrhenatheretea										
H	Eua	3	0	0	*Achillea millefolium*	+	+	+	·	·	·	·	+	+	III
H	Cp(bor)	0	0	0	*Agrostis capillaris*	+	+	+	+	·	·	+	·	+	IV
H	Eua	0	0	0	*Anthoxanthum odoratum* / ***Vaccinio-Piceetea***	+	·	·	+	·	·	·	+	·	II
H / mPh	Eua / E	3 / 0	2.5 / 3	2 / 0	*Briza media* / *Sorbus aucuparia*	+	+	·	·	+	+	·	+	+	III / II
TH / nPh	E / Cp(bor)	3 / 0	2.5 / 2	3 / 1	*Campanula patula* / *Vaccinium myrtillus*	+	+	·	+	2	2	·	+	+	III / II
H / nPh	E / Cp(bor)	3	2.5 / 2	3 / 1	*Centaurea phrygia* / *Vaccinium vitis-idaea*	+	+	·	+	·	1	·	2	+	III
H	Eua / Cp(bor)	3 / 3.5	2 / 0	1.5 / 3	*Galium mollugo* / *Blechnum spicant*	+	+	+	·	+	·	·	·	·	II / I
H	Eua / Cp(arct-alp)	3 / 2.5	0 / 3	0 / 1	*Holcus lanatus* / *Deschampsia flexuosa*	+	1	+	1	2	·	+	1	2	IV / V
H	Eua / E	3 / 2.5	2 / 0.5	0 / 2	*Leucanthemum vulgare* / *Luzula luzuloides*	+	+	·	+	+	+	+	·	+	III / IV
H	Eua	0	0	0	*Plantago lanceolata* / ***Festuco-Brometea***	+	·	·	·	·	·	·	+	+	II
H	Cosm / E	3 / 2	3 / 5	0 / 5	*Rumex acetosa* / *Dianthus carthusianorum*	+	+	·	·	·	+	+	+	·	III / II
H	Eua	2.5 / 3	2.5 / 3	0	*Stachys officinalis* / *Galium verum*	+	+	·	·	·	·	+	+	·	II
H	Eua / P-D	4 / 1.5	4 / 3	0 / 4	*Succisa pratensis* / *Seseli osseum*	+	+	+	·	+	·	·	+	·	III
TH / Ch	E-Pan	2.5 / 2	3 / 4	0	*Viola tricolor* ssp. *tricolor* / *Thymus glabrescens*	+	+	+	·	·	·	+	·	+	II

					Variae Syntaxa										
MPh	Eua	3	2	2	*Betula pendula*	·	·	·	+	+	·	·	·	+	II
mPh	Cp(bor)	2	0	0	*Juniperus communis*	·	·	·	+	+	·	·	·	·	II
nPh	Ec	2.5	3	0	*Cytisus nigricans*	·	·	·	·	·	+	+	+	·	II
H	Eua	4.5	0	4	*Agrostis gigantea*	+	+	+	1	+	·	+	1	·	IV
H	Eua	2	3	0	*Calamagrostis arundinacea*	+	·	·	·	+	·	·	·	+	II
H	Eua	2	2.5	0	*Carex montana*	+	·	+	·	·	·	·	·	·	II
H	Eua	3	2	2	*Cruciata glabra*	+	+	·	·	·	·	·	·	·	II
H	Cosm	4	0	0	*Deschampsia caespitosa*	+	·	·	+	·	·	+	+	·	III
H	Cosm	4	3	0	*Dryopteris filix-mas*	·	·	·	·	1	·	·	+	·	II
H	Ec(mont)	4	2	4	*Gentiana asclepiadea*	·	·	·	+	+	·	·	·	·	II
H	Cp	3	3	3	*Gnaphalium sylvaticum*	·	·	·	·	+	·	+	·	·	II
H-Hh	Eua	5	0	0	*Lysimachia vulgaris*	+	+	·	·	·	·	·	·	·	II
Ch	Ec	2.5	3	3	*Thymus dacicus*	+	·	+	·	·	·	·	·	·	II
G	Eua	4	2.5	4	*Veratrum album*	+	+	·	·	·	+	·	·	·	II

where: L.f.-Life forms; F.e.-Floristic elements; U-Humidity; T-Temperature; R-The chemical reaction of the soil.

Species that occur in a single relevée: *Ajuga reptans* (6); *Anemone nemorosa* (6); *Bromus commutatus* (3); *Carlina acaulis* (4); *Corylus avellana* (5); *Crataegus monogyna* (8); *Dianthus armeria* (1); *Juncus effusus* (6); *Leontodon autumnalis* (4); *Lychnis viscaria* (1); *Malus sylvestris* (4); *Molinia caerulea* (5); *Pteridium aquilinum* (5); *Pyrus pyraster* (5); Ranunculus *polyanthemos* (1); *Silene nutans* (8); *Senecio germanicus* (8); *Senecio jacobaea* (1); *Thymus pulegioides* (4); *Verbascum nigrum* (4); *Veronica chamaedrys* (1); *Veronica teucrium* (4).

Place and date of relevée: 1 – 3 Ponoare Glade (Bihor county) 23.07.2011; 4 – Brătcoaia Glade (Bihor county) 30.07.2010; 5 – Crişului Văratec Valley (Bihor county) 22.08.2010; 6 – Ronțaru Hill– Câmp Moţi (Bihor county) 30.04.2011; 7 – 8 Carpeni Hill – Călugări (Bihor county) 05.08.2011; 9 – Valea cea Mică Valley– Tărcăița (Bihor county) 11.08.2011.

Table 2

Festuco-Genistelletum association Issler 1927

L.f.	F.e.	U.	T.	R.	Number	1	2	3	4	5	6	7	8	9	K
					Altitude (m.s.m.)	730	710	630	690	600	570	550	570	650	
					Vegetation cover (%)	100	100	100	100	100	100	100	100	100	
					Exposition	N	NE	E	SE	SE	N	SV	NE	N	
					Slope (º)	10	5	12	10	10	10	20	10	18	
					Area (m²)	100	100	100	100	100	100	100	100	100	
H	Cp(bor)	3	0	0	As. *Festuca rubra*	4	2	3	4	4	2	4	3	3	V
H	Atl-M-Ec	3	3	3	As. *Genistella sagittalis*	2	3	2	2	2	4	2	2	2	V
					Genistion pillosae										
nPh	Cp(bor)	0	2	1	*Vaccinium myrtillus*	·	1	+	·	·	·	+	+	·	III
nPh	Cp(bor)	3	2	1	*Vaccinium vitis-idaea*	·	+	1	·	·	·	+	1	·	III
H	Cp(bor)	2.5	3	2.5	*Hieracium umbellatum*	·	+	·	·	+	+	+	+	+	IV
					Nardetalia										
H	Cp(bor)	3.5	3	3	*Carex pallescens*	+	·	+	+	·	·	·	+	·	III
H	Eua	4	3	2	*Hypericum maculatum*	+	·	+	+	+	+	+	+	·	IV
H	E	0	0	1.5	*Nardus stricta*	+	2	1	+	1	·	1	1	2	V
					Nardo-Callunetea										
H	E	0	3	2	*Danthonia decumbens*	·	+	·	+	·	·	·	·	·	II
Ch-nPh	Eua	2.5	3	2	*Genista tinctoria*	+	+	·	·	·	·	·	·	·	II
H	E	2.5	0	0	*Hieracium pilosella*	·	+	·	+	+	+	+	+	1	IV
H	E	3	0	3	*Luzula campestris*	·	·	+	·	·	·	·	·	·	I
H	Eua	0	0	0	*Potentilla erecta*	+	·	+	+	+	+	+	+	+	V
Ch	Eua	2	2	2	*Veronica officinalis*	+	+	+	·	·	+	+	+	·	IV
H	Eua	2.5	3	2	*Viola canina*	·	·	·	·	+	·	+	·	·	II
					Arrhenatheretalia										
H	Eua	0	3	0	*Briza media*	+	+	+	+	+	+	·	·	+	IV
H	Eua	3	0	3	*Galium mollugo*	·	·	+	+	·	·	·	·	+	II
H	Eua	3.5	3	0	*Holcus lanatus*	+	+	·	·	+	·	+	·	·	III
H	Eua	2.5	0	0	*Leontodon hispidus*	·	·	·	·	+	+	·	·	·	II
H	Eua	3	0	0	*Leucanthemum vulgare*	·	·	·	·	+	+	·	·	·	II
H	Eua	2.5	0	0	*Lotus corniculatus*	·	·	·	+	+	·	·	·	·	II
H	Eua	2.5	3	3	*Senecio jacobaea*	+	+	·	·	+	+	+	·	·	III
Ch	Ec	2.5	3	3	*Thymus pulegioides*	·	·	+	+	+	+	·	·	+	III
H	Eua	0	0	0	*Plantago lanceolata* / ***Molinio-Arrhenatheretea***	·	·	+	·	·	·	·	·	+	II
H	Eua / Cp	0 / 3	0	0	*Poa pratensis* / *Anthoxanthum odoratum*	·	·	+	+	+	+	+	+	·	IV / V
H	Eua / Ec	3	3 / 2.5	3	*Polygala vulgaris* / *Centaurea phrygia*	+	·	+	·	+	+	·	·	·	II
H	Eua / E	3	3	2.5 / 0	*Stachys officinalis* / *Hypochaeris radicata*	+	·	+	+	+	+	·	·	+	III / II
H	Eua	3.5 / 4	3	0 / 4	*Succisa pratensis* / *Lathyrus pratensis*	+	·	·	·	+	+	·	+	·	II
H	Eua / E	3.5 / 4	3	0 / 4	*Molinia caerulea* / *Trifolium hybridum*	+	·	+	·	·	+	·	·	+	II

					Festuco-Brometea										
H	E	2	0	4	*Anthyllis vulneraria*	·	·	·	·	·	+	·	1	·	II
H	Eua	2.5	4	4	*Brachypodium pinnatum*	·	+	·	·	·	+	·	·	1	II
TH-H	Eua	2.5	3.5	0	*Carlina vulgaris*	+	+	·	+	+	·	·	·	+	III
H	E	2	5	5	*Dianthus carthusianorum*	+	+	+	1	+	·	+	+	1	V
H	Eua	2	3	4	*Euphorbia cyparissias*	·	·	·	+	+	·	·	·	·	II
H	Eua	2.5	2.5	0	*Galium verum*	·	·	+	·	+	+	+	+	·	III
H	Eua	3	3	0	*Hypericum perforatum*	·	·	·	·	·	+	·	·	+	II
H	Cp	2	0	4.5	*Koeleria macrantha*	·	·	·	+	·	+	·	·	·	II
H	P-D	1.5	4	4	*Seseli osseum*	+	·	+	+	+	+	·	·	·	III
H	Eua(cont)	2.5	2	4	*Trifolium montanum*	+	+	·	+	+	+	·	+	+	IV
					Variae Syntaxa										
MPh	Eua	3	2	2	*Betula pendula*	·	·	·	+	·	+	·	·	·	II
mPh	E	2.5	3	3	*Crataegus monogyna*	·	·	·	·	+	+	+	+	·	III
mPh	Cp(bor)	2	0	0	*Juniperus communis*	·	·	·	+	+	+	·	·	·	II
mPh	Eua	2	3	3	*Prunus spinosa*	·	·	·	+	·	·	·	+	·	II
nPh	Ec	2.5	3	0	*Cytisus nigricans*	·	·	+	·	·	·	+	+	·	II
H	Eua	4.5	0	4	*Agrostis gigantea*	+	+	·	·	·	·	·	·	·	II
H	Eua	2	2.5	0	*Carex montana*	+	+	·	·	·	+	·	·	·	II
H	Eua	2.5	3	2	*Calamagrostis arundinacea*	+	1	·	·	·	·	·	·	·	II
H	Eua	3	2	2	*Cruciata glabra*	+	+	+	·	·	+	·	·	+	III
H	Cp(arct-alp)	2	0	1	*Deschampsia flexuosa*	1	1	2	·	·	·	1	2	1	IV
H	E	4	3	4	*Hypericum tetrapterum*	·	·	·	·	·	+	·	+	·	II
H-Hh	Eua	5	0	0	*Lysimachia vulgaris*	+	+	·	·	·	+	·	·	·	II
H-G	Cosm	2	3	2	*Rumex acetosella*	·	·	+	·	·	·	+	+	·	II
H	Eua	3.5	3	3	*Senecio germanicus*	+	+	·	·	·	·	·	·	·	II
H	Eua	2	2	4	*Silene nutans*	+	+	·	+	+	·	+	+	+	IV
TH-H	Eua	2	3	4	*Verbascum nigrum*	+	+	·	+	·	+	·	·	·	III

where: L.f.-Life forms; F.e.-Floristic elements; bor-boreal; cont-continental; arct-alp-arctic-alpine; U-Humidity; T-Temperature; R-The chemical reaction of the soil.

Species that occur in a single relevée: *Achillea millefolium* (5); *Ajuga genevensis* (3); *Calamagrostis epigeios* (3); *Campanula patula* (6); *Carlina acaulis* (6); *Carlina biebersteinii* (1); *Centaurea nigrescens* (4); *Corylus avellana* (6); *Dianthus armeria* (4); *Erigeron annuus* (5); *Luzula luzuloides* (7); *Lychnis coronaria* (3); *Lythrum salicaria* (6); *Medicago falcata* (6); *Phleum pretense* (4); *Prunella vulgaris* (6); *Pyrus pyraster* (4); *Ranunculus polyanthemos* (3); *Rhinanthus minor* (5); *Rosa canina* (4); *Salix capraea* (6); *Scabiosa ochroleuca* (9); *Senecio sylvaticus* (5); *Sorbus aucuparia* (4); *Stachys recta* (3); *Thymus glabrescens* (6); *Trifolium medium* (4); *Trisetum flavescens* (3); *Viola tricolor* ssp. *tricolor* (3).

Place and date of relevée: 1 – 2 Ponoare Glade (Bihor county) 23.07.2010; 3 – Arinda (Bihor county) 23.06.2011; 4 – Ponoraş Glade (Arad county) 19.07.2011; 5 – Tarniţa Hill – Briheni (Bihor county) 29.07.2011; 6 – Carpeni Hill – Călugări (Bihor county) 05.08.2011; 7 – 8 Ţarinii Valley – Călugări (Bihor county) 05.08.2011; 9 – Valea cea Mică Valley – Tărcăiţa (Bihor county) 11.08.2011.

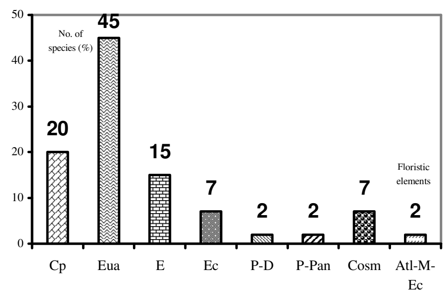

Fig. 1 Spectrum of floristic elements of the *Nardo-Festucetum rubrae fallax* association Puşcaru et al. 1959

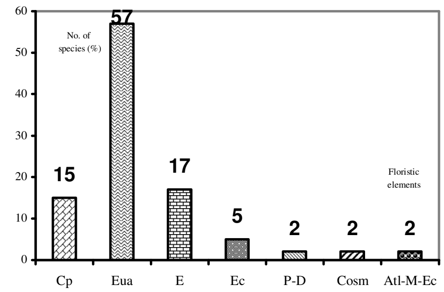

Fig. 2 Spectrum of floristic elements of the *Festuco-Genistelletum* association Issler 1927

where: Cp-Circumpolar; Eua-Eurasian; E-European; Ec-Central European; P-D-Ponto-Dacian; P-Pan-Ponto-Pannonian; Cosm-Cosmopolitan; Atl-M-Ec-Atlantic-Mediterranean-Central European

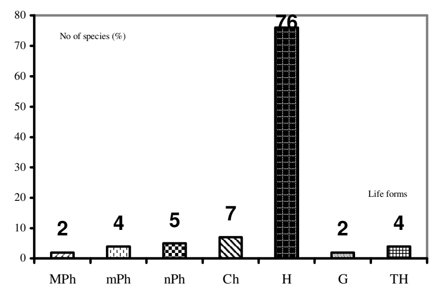

Fig. 3 The life forms spectrum of *Nardo-Festucetum rubrae fallax* association Puşcaru et al. 1959

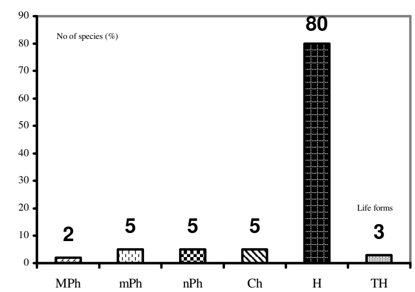

Fig. 4 The life forms spectrum of *Festuco-Genistelletum* association Issler 1927

where: MPh - Megaphanerophyte; mPh - Mezophanerophyte; nPh - Nanophanerophyte; Ch - Camephyte; H - Hemicryptophyte; G - Geophyte; TH - Biannual terophyte

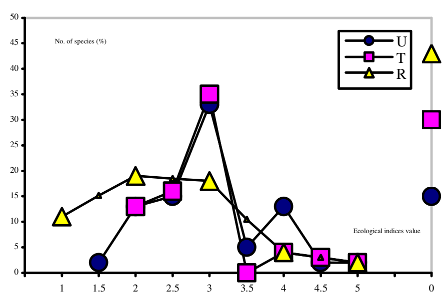

Fig. 5 Diagram of ecological indices for the *Nardo-Festucetum rubrae fallax* association Puşcaru et al. 1959

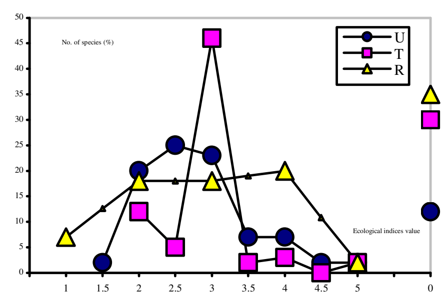

Fig. 6 Diagram of ecological indices for the *Festuco-Genistelletum* association Issler 1927

where: U - humidity, T - temperature, R - the chemical reaction of the soil

In the phytocoenoses of these associations, the spectrum of the floristic elements reveals the presence in a high percentage of eurasian species, followed by circumpolar and european species (Fig. 1, Fig. 2). The life forms best represented are the hemicryptophytes, followed by camephytes and nanophanerophytes (Fig. 3., Fig. 4). In the ecological indices spectrum you can see the large share of xero-mezophyles plus mezophyles (Fig. 5, Fig. 6). Because phytocoenoses grow on acid soils, acidophilous species are present in high percentage, followed by acid-neutrophilous and weak acid-neutrophilous species (Fig. 5, Fig. 6). In terms of temperature, the species with the highest weight in floristic composition are the micro-mesothermophilous species followed by amphitolerant and micro-thermophilous species (Fig. 5, Fig. 6).

CONCLUSIONS

These acidophilous associations built by *Festuca rubra*, *Nardus stricta* and *Genistella sagittalis* are transitional phytocoenoses to lawns of *Nardus stricta*, which is a transformation process accelerated by the intense and continuous grazing in the area. These phytocoenoses have little grazing importance, being in areas with acidic soils and degraded lands.

Overgrazing on acidophilous grassland in the Codru-Moma Mountains area is one of the biggest threats, especially in inaccessible regions.

The occurrence of these two associations in Codru-Moma Mountains is due largely to the zoo-anthropogenic factor, and they have a secondary character, having low productivity and economic value.

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