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SPECIES-RICH NARDUS GRASSLANDS FROM THE NORTHERN PART OF THE BIHOR MOUNTAINS

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ABSTRACT. This paper presents phytocoenologic, ecological and eco-protective research made in the priority habitat 6230* - Species-rich *Nardus grasslands*, on siliceous substrates in mountain areas, identified in the northern part of Bihor Mountains. The phytocoenoses of the three studied associations: *Violo declinatae - Nardetum* Simon 1966, *Festuco rubrae - Nardetum strictae* Csürös et Resmeriţă 1960 and *Carici - Nardetum strictae* (Resmeriţă 1984) Pop et Resmeriţă 1986, assigned the alliance *Potentillo - Nardion* Simon 1959 - grows on large surfaces located at altitudes ranging from 900-1585 m, on acidic soils compacted more or less, used as pastures. The 26 phytocoenologic samplings conducted and summarized in tables include a number of 82 species revealed. Among these, there are a number of vulnerable species (*Arnica montana, Pedicularis limnogena*), endemic (*Thymus bihoriensis*), rare (*Sagina saginoides, Campanula serrata, Pseudorchis albida, Dactylorhiza maculata, Viola dacica*), included in the Red List.

Keywords: *Violo declinatae – Nardetum*, *Festuco rubrae – Nardetum strictae*, *Carici – Nardetum strictae*, Bihor Mountains, Red Listed plants

INTRODUCTION

The Bihorului Mountains represent the central orographic node of the Apuseni Mountains (Oancea et al., 1987). With an elevation amplitude between 800 meters and 1700 meters, these mountains have a strong fragmentation on a complicated assembly of calcareous rocks, karstificable, bordered by non-karstificable rocks: sandstone, shale purple, breccia, andesite, conglomerates (Ianovici et al., 1976). The climate of the Bihor Mountains is generally moist and cool. Average annual air temperature is of +2°C in northern and southern massifs and of 4°C in central limestone platform. In January, the average air temperature is of -7°C in the high mountains and of -3°C in the valleys, while in July recorded average temperatures are of 10ºC. Prevailing wind is western, bringing of rain and causing a large number of cloudy days. Average annual rainfalls in the highlands of Bihor Mountains exceed 1400 mm (Călinescu et al., 2002).

The grasslands included in the European priority habitat 6230* have a primary origin, growing on rocky, acid areas, on soils with brief profile, from the mountain or alpine storeys, or secondary origin (Pop et Florescu, 2008). The physical and climatic conditions and the continuous zoo-anthropogenic pressure favors the development of the secondary pastures with *Nardus stricta* on wide areas, over 1000-1400 ha, ranked of deforested spruce forests or spruce-beech forests on the mountain massif Măgura Vânătă, in Şesul Padiş in Vărăşoaia , Onceasa, in Şesul Gârzii as well as in the subalpine zone above the limit of the spruce forest and juniper and blueberry shrubs in the northern territory, on Piatra Arsă, Şaua Cumpănăţelu, Coasta Brăiesei. The secondary pastures from the mountain and subalpine storeys have an estimated age of 400-500 years, but evolution to the pastures dominated by *Nardus stricta* can take place in a much shorter time of only 7-10 years, during which this species can completely replace the original vegetation due to intensive grazing with sheep (Puşcaru-Soroceanu et al., 1963).

The European priority habitat 6230* – Species-rich *Nardus grasslands* in siliceous substrates in mountain areas, includes the permanent secondary grasslands with *Nardus stricta*, xerophylous, mesophylous and meso-hygrophylous, whose phytocoenoses have a high ecological plasticity which imprint the habitat a great structural heterogeneity (Bărbos et Sima 2008). The strongly degraded grasslands due to grazing, with a small number of species, were excluded from this habitat (Gafta et Mountford, 2008).

The European priority habitat 6230* – Species-rich *Nardus grasslands* in siliceous substrates in mountain areas, include in the Romanian classification, the following habitats: R3608 - Southeastern Carpathian pastures with *Scorzonera rosea* and *Festuca nigrescens*, respectively R3609 - Southeastern Carpathian pastures with *Nardus stricta* and *Viola declinata* (Doniţă et al., 2005).

Phytosociological point of view, to this habitat corresponds to the following coeno-taxa: *Scorzonero roseae – Festucetum nigricantis* (Puşcaru et al. 1956) Coldea 1987 and *Violo declinatae – Nardetum* Simon 1966.

The association *Scorzonero roseae – Festucetum nigricantis* (Puşcaru et al. 1956) Coldea 1987 is a synonym for the association *Festuco rubrae – Nardetum strictae* Csürös et Resmeriţă 1960 (Sanda et

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al., 2008; Velev et Apostolova, 2009). Taking into account this synonymy, the absence of the species Scorzonera rosea in the researched territory and the phytocoenological and stationary conditions in the northern part of the Bihor Mountains, we still use the synonym name, which is closer to the reality founded in the ground.

The association *Carici – Nardetum strictae* (Resmeriţă 1984) Resmeriţă et Pop 1986, grouping *Nardus grasslands* with hydrotrophyc, meso-hygrophylous to mesophylous character, developed on small surfaces in the vicinity of other pasture associations with *Nardus stricta*, together with the associations *Scorzonero roseae – Festucetum nigricantis* (Puşcaru et al. 1956) Coldea 1987 1987 and *Violo declinatae – Nardetum* Simon 1966, belongs the alliance *Potentillo – Nardion* Simon 1959, the order NARDETALIA Preising 1949.

MATERIALS AND METHODS

During field observations and research methods we used phytosociological research of European Central School, based the principles and methodology developed by Braun-Blanquet (1928) and adapted by Borza (1934), Borza et Boşcaiu (1965) to the features of the vegetation cover in our country. The phytocoenological relevées made during the 10 study trips conducted during July 2010 to October 2012, included floristic and physiognomic homogenous samples, which were chosen in fragments characteristic surfaces of phytocoenoses studied, with their size 100 sqm.

Quantitative assessment of the participation of each species in the description of associations was using the index of abundance – dominance (AD) after Braun-Blanquet et Pavillard (1928) system evaluation, completed by Ellenberg et Tüxen (1937). The association table prepared following Cristea et al. (2004) contains information regarding the species composing the association - life forms, floristic element, ecological indices (humidity, temperature, chemical reaction of the soil), karyologic indexes lollowing Sanda et al. (2003), specific quality index of value forage (IC) after Resmeriţă (1970), the serial number of association and the number of relevées performed for each association, altitude (msm), exhibition, inclination (degrees), the constancy (K) and the average abundance-dominance (ADm) were calculated and introduced at the end of the table. Pastoral value (PV) was calculated according the geobotany method (Anghel et al., 1971; Maruşca, 2001), using the formula:

PV = Σ (ICi x ADmi) / 100, where: ICi = specific quality index of value forage for the taxon i, ADmi = average abundance-dominance for the taxon i.

Depending on pastoral value was calculated the pasture capacity (PC), without determining the analyzed pasture production, using the formula:

PC = PV x c, where PV = pastoral value, c = 0,4-0,6 coefficient.

To complete ecological study of the association we represented graphically the distribution of lifeforms, floral elements, environmental factors and karyologic indexes.

The names of the plant species are in accordance with Ciocârlan (2009).

RESULTS AND DICUSSIONS

Flora of three associations phytocoenoses is generally monotonous and poor, comprising a total of 78 taxa (Table 1), of which 54 belong to the association *Festuco rubrae – Nardetum strictae* Csürös et Resmeriţă 1960 (hereinafter referred "association 1"), 53 belong to the association *Violo declinatae – Nardetum* Simon 1966 ("association 2") and 29 belong to the association *Carici – Nardetum strictae* (Resmeriţă 1984) Resmeriţă et Pop 1986 ("association 3"). Relative to total 390 taxa in the floristic structure of Romanian *Nardus grasslands* (Bărbos et al., 2008), the number of taxa identified by us in the *Nardus grasslands* from northern part of the Bihor Mountains seems quite low (20%). Best represented (26.92%) are characteristic and differential species belonging to the order **NARDETALIA** and class **NARDO-CALLUNETEA** (*Nardus stricta, Festuca nigrescens, Campanula abietina, Viola declinata, Hypochaeris uniflora, Potentilla aurea ssp.chrysocraspeda, Geum montanum, Vaccinium myrtillus, Vaccinium vitis-idaea, Potentilla erecta, Danthonia decumbens*), showing character acidophilous - strong acidophilous of substrates that develops the *Nardus grasslands*. A large number of poor acidophilous species or euri-ionical species (*Agrostis capillaris, Juncus effusus, Molinia caerulaea, Carex ovalis, Cerastium fontanum ssp. fontanum, Cerastium fontanum ssp. vulgare, Poa pratensis, Stellaria graminea, Stachys officinalis, Phleum pratense, Anthoxanthum odoratum, Veronica chamaedrys, Deschampsia caespitosa, Leontodon autumnalis, Euphrasia stricta, Prunella vulgaris* etc.) are transgressive from the class **MOLINIO-ARRHENATHERETEA** (36.7%). In addition to these, in the analyzed phytocoenoses appear transgressive species from the class **SCHEUCHZERIO-CARICETEA NIGRAE** (5.12% - *Juncus filiformis, Pedicularis limnogena, Eriophorum angustifolium, Parnasia palustris*). The few species from the class **VACCINIO-PICEETEA** (6.41% - *Deschampsia flexuosa, Juniperus communis, Campanula serrata* etc.) and from the class **QUERCO-FAGETEA** (3.85% - *Veronica officinalis, Crocus vernus, Luzula luzuloides*) are remnants of juniper shrubs , spruce stands and European beech - silver fir mixed stands grubbed over the years to increase the grazing area. A fairly high number of accidental species found favorable conditions for development in these phytocoenoses (19.23% - *Laserpitium krapfii, Gnaphalium sylvaticum, Festuca* *ovina, Luzula luzuloides ssp. cupressa, Viola dacica, Alchemilla vulgaris, Sagina saginoides* etc.).

The phytocenoses of the association 1, something richer in species, registered an average of 20.27 species / relevée. As a result of the settlement and acidification process of the soil, the grass species reduce their level of abundance-dominance, replaced by matgrass. Thus, the phytocoenoses of the association 2 registered only 19.3 species/ relevée. The same phenomena of settlement and gleyzation determines the reduced number of species/relevée for the association 3, only 16.6, the hygrophylous *Nardus grasslands* populating small areas on marshy plateaus and gentle coasts.

The main factors influencing the variation of the number of species/ relevée are: the thickness of the litter, how to use the grasslands and pH (Maruşca, 2010). The litter layer is thinner, the number of species/ relevée is lower. Regarding the use of grasslands, the actual situation in the territories surveyed from the northern part of Bihor Mountains confirm that the cattle pastures, sheep pastures or mixed pastures have a lower biodiversity of the vegetal species than hayfields or grazed meadows in spring and autumn.

Tabel 1. The floristic inventory of *Nardus grasslands* from the northern part of Bihor Mountains

Life forms	Floristic elements	U	T	R	G	IC	Nr.releveu	K	ADm	K	ADm	K	ADm
							Asociatia	1		2		3	
							Numar relevee insumate	11		10		5	
							Altitudine (m)	850-1610		1240-1550		1240-1420	
							Expozition	E, SE, SV		E,SE,SV,V, NV		S, SE	
							Slope (°)	5-35		10-40		0-5	
H	E	0	0	1.5	D	1	*Nardus stricta*	V	65.23	V	80	V	62.50
H	Cp	3	0	0	P	4	*Festuca rubra*	V	8.50	III	2.85	IV	1.30
H	E	3	1	2	P	3	*Festuca nigrescens*	III	3.41	II	0.15	.	.
H	Cp-Bo	4.5	3	0	P	0	*Carex flava*	.	.	.	.	III	1.30
							Potentillo-Nardion						
TH	Carp-B	3.5	2	2	P	0	*Campanula abietina*	IV	0.31	IV	0.35	.	.
H	Carp-B	3.5	2	2	DP	0	*Viola declinata*	II	0.13	V	1.40	.	.
H	Alp-Carp	3	2.5	2	DP	0	*Hypochaeris uniflora*	I	0.09			.	.
Ch	Carp-B	1.5	3.5	2.5	P	1	*Thymus balcanus*	I	0.04	II	0.60	.	.
H	Carp-B	0	1.5	2	N	2	*Potentilla aurea ssp.chrysocraspeda*	.	.	IV	0.85	II	1.10
H	E	2.5	1.5	1.5	P	0	*Geum montanum*	.	.	I	0.10	.	.
H	Eua	3.5	2	4	P	0	*Hieracium aurantiacum*	.	.	I	0.10	.	.
							Genistion pillosae						
nPh (Ch)	Cp-Bo	0	2	1	D	0	*Vaccinium myrtillus*	IV	1.13	III	1.20	II	0.20
Ch (nPh)	Cp-Bo	3	2	1	D	0	*Vaccinium vitis-idaea*	IV	0.32	II	0.15	.	.
							Nardetalia						
H	Eua	0	2	2	P	0	*Luzula sudetica*	III	0.22	III	0.30	II	0.20
H	E	3	2	0	P	4	*Alchemilla vulgaris*	I	0.09	.	.	.	.
H	Eua	4	3	2	DP	-1	*Hypericum maculatum*	I	0.09	II	0.15	I	0.10
H(Ch)	Eua	2	1	3	P	0	*Antennaria dioica*	I	0.04	I	0.05	.	.
H	E	3	2.5	3	P	-1	*Arnica montana*	.	.	I	0.05	.	.
							Nardo-Callunetea						
H	Eua	0	0	0	P	1	*Potentilla erecta*	V	0.90	II	0.20	IV	0.40
H	Cp	3	0	3	D	0	*Luzula campestris*	III	0.22	.	.	II	0.20
H	E	0	3	2	P	1	*Danthonia decumbens*	I	0.09	.	.	.	.
H	Cp	0	0	0	P	3	*Agrostis capillaris*	IV	0.36	V	0.90	II	0.20
H	Cosm	4.5	3	3	P	0	*Juncus effuses*	IV	0.72	I	0.10	V	3.20
H	Eua	4	3	0	P	0	*Molinia caerulea*	IV	0.77	I	0.10	II	0.20
H	Cp	4	2.5	3	P	0	*Carex ovalis*	III	0.27	II	0.15	IV	0.40
H	Cp	3.5	3	3	P	0	*Carex pallescens*	II	0.13	.	.	III	0.30
H	Eua	3.5	0	0	P	5	*Trifolium repens*	II	0.13	II	0.15	.	.
Ch(H)	Eua	3	0	0	P	0	*Cerastium fontanum ssp.fontanum*	I	0.09	.	.	.	.
H	Cp	3	0	0	P	5	*Poa pratensis*	I	0.09	.	.	.	.
H(Ch)	E	3	3	3	P	-1	*Polygala vulgaris*	I	0.09	II	0.20	.	.

H	Eua	3	3	4	D	0	*Primula elatior*	I	0.09	.	.	.	.
H	Cosm	3	0	0	D	0	*Rumex acetosa*	I	0.09	I	0.10	.	.
H	Eua	2.5	2	3	D	-2	*Stellaria graminea*	I	0.09	I	0.10	.	.
H	Eua	3.5	0	0	P	5	*Phleum pretense*	I	0.09	.	.	.	.
Ch	EC	2.5	3	3	D	1	*Thymus pulegioides*	I	0.09	II	0.65	.	.
H	Eua	3	3	0	D	0	*Stachys officinalis*	I	0.09	.	.	.	.
H-Ch	Cosm	3	0	0	P	0	*Cerastium fontanum ssp.vulgare*	I	0.04	III	0.25	II	0.20
H(Ch)	E	3	3	3	P	0	*Prunella vulgaris*	I	0.04	II	0.20	.	.
H	Eua	0	0	0	P	1	*Anthoxanthum odoratum*	I	0.04	II	0.60	II	0.20
H-Ch	Eua	3	0	0	P	0	*Veronica chamaedrys*	I	0.04	I	0.10	.	.
H	Cosm	4	0	0	DP	2	*Deschampsia caespitosa*	I	0.04	I	0.55	V	3.20
H	Eua	3	0	0	DP	1	*Leontodon autumnalis*	I	0.04	.	.	I	0.10
Th	E	3	3	0	N	0	*Euphrasia stricta*	.	.	II	0.15	.	.
H	EC	2.5	0	0	D	0	*Carlina acaulis*	.	.	I	0.10	.	.
H	E	3	3	3	D	3	*Cynosurus cristatus*	.	.	I	0.10	.	.
H	Eua	4	4	4	P	0	*Juncus inflexus*	.	.	I	0.10	.	.
G	E	4	2	2	P	0	*Dactylorhiza maculate*	.	.	.	.	II	0.20
H	Eua	4.5	3	3	P	0	*Juncus conglomerates*	.	.	.	.	II	1.10
H	E	5	3	0	P	0	*Caltha palustris ssp.laeta*	.	.	.	.	II	0.20
H	E	4.5	0	4.5	DP	1	*Crepis paludosa*	.	.	.	.	II	0.20
							Scheuchzerio-Caricetea nigrae						
H	Cp-A-a	4.5	2.5	2.5	P	0	*Juncus filiformis*	I	0.04	I	0.05	.	.
H	Carp-B	5	2	2	N	0	*Pedicularis limnogena*	.	.	.	.	III	0.30
G	Cp-Bo	4.5	3	3	D	0	*Eriophorum angustifolium*	.	.	.	.	III	1.20
H	Cp	4	2	5	DP	0	*Parnasia palustris*	.	.	.	.	II	0.20
							Juncetea trifidi						
H	E	2.5	1.5	4	P	0	*Carex sempervirens*	.	.	I	0.10	.	.
							Vaccinio-Piceetea						
H	Cp-A-a	2	0	1	P	2	*Deschampsia flexuosa*	V	10.86	III	1.20	.	.
mPh	Cp-Bo	2	0	0	D	0	*Juniperus communis*	III	1.45	I	0.10	.	.
MPh	E	0	0	0	D	0	*Picea abies*	II	0.18	.	.	.	.
H	Carp (End)	0	2.5	0	DP	0	*Campanula serrata*	I	0.09	I	0.05	.	.
G	Eua	4	2.5	4	DP	0	*Veratrum album*	.	.	I	0.10	.	.
						0	*Polytrichum juniperinum*	I	0.91	.	.	IV	15.50
						0	*Polytrichum strictum*	I	0.50	.	.	IV	3.10
							Querco-Fagetea						
Ch	Eua	2	2	2	P	0	*Veronica officinalis*	II	0.18	II	0.15	I	0.10
G	Carp-B	3	1	2	DP	0	*Crocus vernus*	I	0.09	II	0.15	I	0.10
H	E	2.5	2.5	2	DP	0	*Luzula luzuloides*	.	.	I	0.10	.	.
							Variae syntaxa						
H	Alp-Carp-B	0	0	3	D	0	*Laserpitium krapfii*	II	0.13	I	0.05	.	.
Ch	Carp (End)	2.5	2	4	P	1	*Thymus bihoriensis*	II	0.18	I	0.55	.	.
Th-TH	Cosm	3.5	0	0	P	3	*Poa annua*	I	0.09	I	0.15	I	0.10
H	Cp	3	3	3	P	0	*Gnaphalium sylvaticum*	I	0.09	III	0.30	.	.
H	Alp.	3.5	2	4	P	0	*Epilobium alpestre*	I	0.09	.	.	.	.
H	Eua	2	0	2	D	1	*Festuca ovina*	I	0.09	III	0.25	.	.
H	E	2.5	2.5	2	DP	0	*Luzula luzuloides ssp.cupressa*	I	0.09	.	.	.	.
H	Alp-Carp-B	3.5	2	0	DP	0	*Rumex alpinus*	I	0.09	.	.	.	.
Ch	Ppn	2	4	0	D	1	*Thymus glabrescens*	I	0.09	.	.	.	.
H	Carp-B	3	2	2	N	0	*Viola dacica*	I	0.09	.	.	.	.
H-G	Cosm	3	3	4	DP	0	*Urtica dioica*	.	.	I	0.15	.	.
H	EC	3.5	2	2	P	4	*Alchemilla vulgaris*	.	.	I	0.10	IV	0.40
G	Cosm	2.5	2	0	P	0	*Botrichium lunaria*	.	.	I	0.10	.	.
H(Ch)	Cp-A-a	3.5	0	2	D	0	*Sagina saginoides*	.	.	I	0.10	.	.
G	E	3	2	2		0	*Pseudorchis albida*	.	.	I	0.05	.	.
						0	*Polytrichum commune*	I	0.45	.	.	I	0.10
						0	*Sphagnum cuspidatum*	.	.	.	.	III	11.10

Association 1: *Festuco rubrae – Nardetum strictae* Csürös et Resmeriţă 1960, relevées from: Poiana Florilor, Platoul Padiş, Şesul Padiş, Măgura Vânătă, Cumpănăţelul, Piatra Arsă, Vărăşoaia. Association 2: *Violo declinatae – Nardetum* Simon 1966, relevées from: Vărăşoaia, Şesu Padiş, Măgura Vânătă, Şaua Cumpănăţelul, Piatra Arsă, Biserica Moţului, Şesul Gârzii, Coasta Brăiesei, Poiana Onceasa; Association 3: *Carici – Nardetum strictae* (Resmeriţă 1984) Resmeriţă et Pop 1986, relevées from: Platou Padiş, Valea Gârjoaba, Piatra Arsă. The relevées was realised during September 2010 – July 2012. (Life forms: H – *Hemicryiptophyfites*, Ch – *Chamaephytes*, G – *Geophytes*, Th – *Annual Therophytes*, TH – *Biennial Therophytes*, MPh – *Megaphanerophytes*, mPh – *Mezophanerophytes*, nPh – *Nanophanerophytes*; Floristic elements: Eua – Eurasian, E – European, EC – Central-European, Cp – Circumpolar, Cp-A-a – Circumpolar arctic-alpine, Cp-Bo – Circumpolar boreal, Alp-Carp-B – Alpine-Carpathian-Balkanic, End – Endemic, Ppn – Pontic-Panonic, Cosm – Cosmopolitan; Kariotype: D – Diploid, P – Polyploid, DP – diplo-polyiploid, N – unknown karyotipe.)

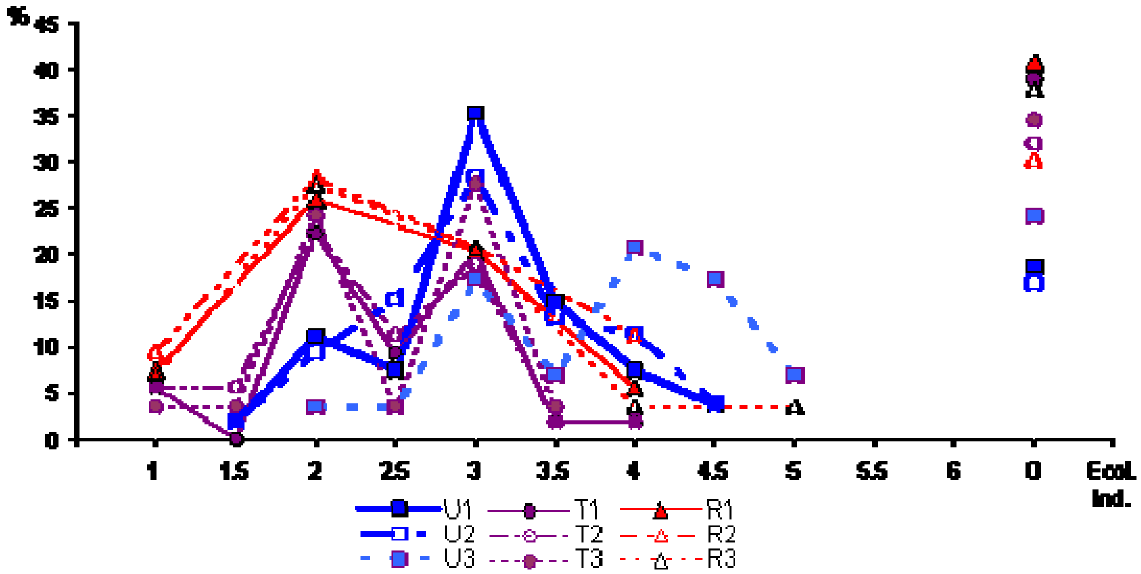

Fig. 1. The diagram of the ecological factors for the phytocoenoses of *Nardus stricta grasslands* associations from northern Bihor Mountains (U – Humidity, T – Temperature, R – Chemical reaction of soil, 1 – association 1, 2 – association 2, 3 – association 3)

The analysis of the ecological indices diagram (Fig. 1) reveals the prevalence of the mesophylous species for the associations 1 and 2 (U13+3.5 = 50%, U23+3.5 = 41.51%), respectively of the meso-hygrophylous species for the association 3 (U34+4.5 = 37.93%). In the case of associations 1 and 2, the mesophylous species are accompanied by a large group of xero-mesophylous species (U12+2.5 = 18.52%, U22+2.5 = 24.52%) and amphitolerant species (U10 = 18.52%, U20 = 16.98%) and for the association 3 it is observed the presence of the mesophylous species (U33+3.5 = 24.14%) and amphitolerant species (U30 = 24.13%). Regarding adaptation to thermic regime it is noted the presence to the described *Nardus* grasslands of the micro-thermophylous species (T12+2.5 = 31.48%, T22+2.5 = 33.96%, T32+2.5 = 27, 59%) and euri-thermophylous species (T10 = 38.89%, T20 = 32.07%, T30 = 34.48%), followed closely by micro-mesothermophylous species (T13+3.5 = 22.22%, T23+3.5 = 20.76%, T33+3.5 = 31.03%). Analizing the behavior towards chemical reaction of soil, it is noted in all three associations the massive presence of acidophylous species (R12 = 25.92% , R22 = 28.30%, R32 = 27.59%) and euri-ionical (R10 = 38,89%, R20 = 32.07%, R30 = 34.48%), followed closely by a large group of acid-neutrophylous species that found ecologically optimum in soils with a pH less acidic, ranging from 5.8 to 6.5 (R13 = 20.37%, R23 = 20.75%, R33 = 20.69%).

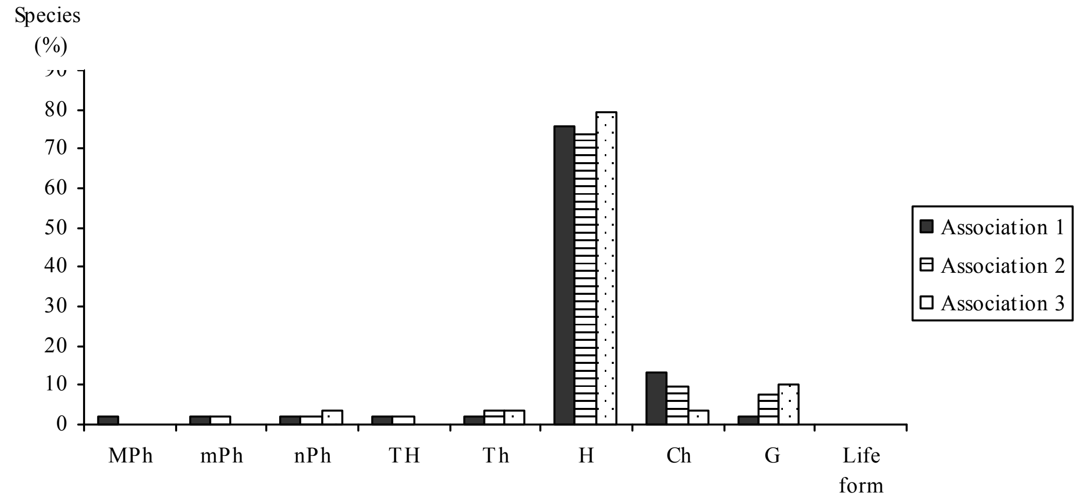

Fig. 2. Life forms spectrum for the *Nardus grassland* associations from northern Bihor Mountains (H – Hemicryiptophyfites, Ch – Chamaephytes, G – Geophytes, TH – Biennial Therophytes, Th – Annual Therophytes, MPh – Megaphanerophytes, mPh – Mezophanerophytes, nPh – Nanophanerophytes, 1,2,3 – index of described association)

Analyzing the life forms spectrum (Fig. 2) it is observed in each of the three associations surveyed the numerical prevalence of hemicryptophytes (H1 = 75.93%, H2 = 73.58%, H3 = 79.31%), followed at a distance of species having other life forms. The high percentage of hemicryptophytes is in accordance with the cold, temperate climate and the soils with sufficient moisture in the stations where vegetate the phytocoenoses these associations. This high percentage of hemicryptophytes indicates a high stability of grassland phytocoenoses dominated by *Nardus stricta*. Low presence of terophytes (Th-TH = 3.45 to 5.66%) show us a low degree of anthropic intervention to these natural habitats.

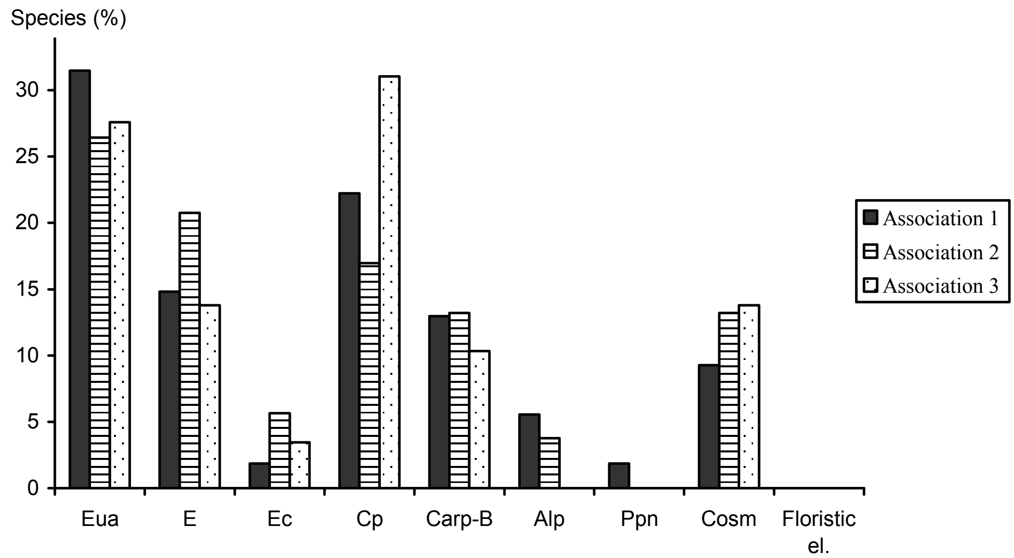

Fig. 3. The spectrum of floristic elements for the phytocoenoses of associations with *Nardus stricta* from northern Bihor Mountains (Eua – Eurasiaa, E – European, Ec – Central European, Cp – Circumpolar, Carp-B – Carpathian and Carpathian-Balkanic, Alp – Alpine, Ppn - Pontic-Panonic, Cosm – Cosmopolitan)

The spectrum of floristic elements (Fig. 3), both under the number report and the presence, is dominated by Eurasian species (Eua1 = 31.48%, Eua2 = 26.42%, Eua3 = 27.59%), Circumpolar species (Cp1 = 22.22% , Cp2 = 16.98%, Cp3 = 31.04%), European (E1 = 14.82%, E2 = 20.75%, E3 = 13.79%), Carpathian and Carpathian-Balkanic (Carp-B1 = 12.96%, Carp-B2 = 13.21%, Carp-B3 = 10.34%) and Cosmopolitan species (Cosm1 = 9.26%, Cosm2 = 13.21%, Cosm3 = 13.79%). The phytocoenoses of the three associations surveyed in the northern Bihor Mountains are characterized by endemic species (*Campanula abietina, Thymus bihoriensis*) or rare (*Arnica montana, Dactylorhiza maculata, Pedicularis limnogena,* *Campanula serrata, Viola dacica, Sagina saginoides, Pseudorchis albida*) included in the European Red List or Romanian Red Lists (Boşcaiu et al., 1994; Dihoru et Dihoru, 1994; Oltean et al., 1994; Dihoru et Negrean, 2009; Bilz et al., 2011).

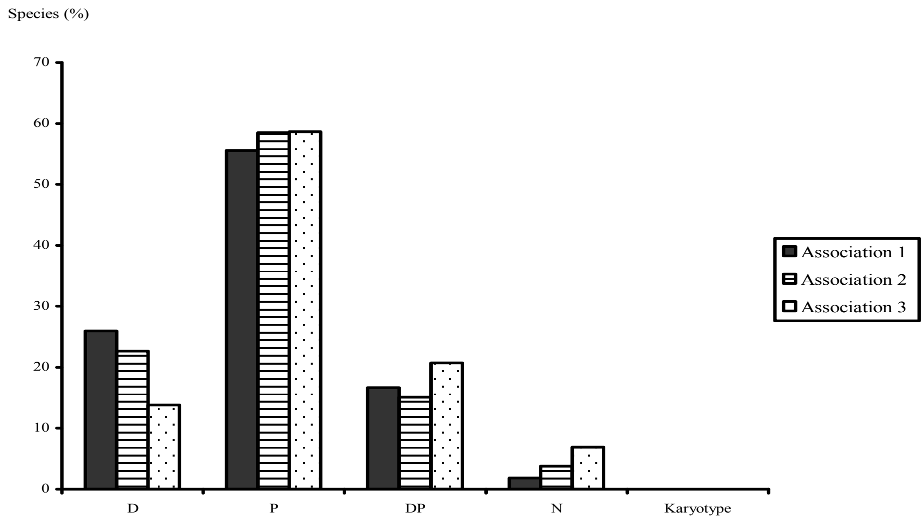

Fig. 4. The karyotype spectrum for the phytocoenoses of associations with *Nardus stricta* from northern Bihor Mountains (D – Diploid, P – Poliploid, DP – Diplo-poliploid, N – unknown karyotype)

From the point of view of plant species karyotypes (Fig. 4) that compose the *Nardus grasslands* studied in the northern part of Bihor Mountains, it is noted a pronounced dominance of polyploid species (P1 = 55.56%, P2 = 58.49%, P3 = 58, 62%) as compared to the diploid species (D1 = 25.93%, D2 = 22.64%, D3 = 13.79%). The diploidy index of the three associations surveyed (with values ranging from 0.23 to 0.46) and high percentage of polyploid species indicates that those *Nardus grasslands* phytocoenoses are adapted to higher altitudes of over 1200 m, having a high stability near the climax if not at this stage.

The *Nardus stricta grasslands* do not have a high economic value, being used mostly as pasture for cattle, sheep or mixed pasture, rarely as grazed meadows in spring and autumn. Due to the abundance-dominance of Nardus stricta species, that pastures have a low pastoral value (VP1 = 1.35, VP2 = 1.03, VP3 = 0.79), which corresponds to weak capacity of grazing meadows (Anghel, 1971). The pastoral value decreases when the surfaces with *Vaccinium sp*. are larger, especially in areas with severe slope to steep and as a result of sporadically grazing or abandoned. Under these conditions, the wooden species (*Picea abies, Juniperus communis*) reappear, develop over time, showing trends in these *Nardus grasslands* phytocoenoses to the original forest phytocoenoses. The grasslands where *Festuca rubra* and *Agrostis capillaris*, along with other grasses, registered higher values of abundance-dominance, developed generally low to medium slopes inclined, have a higher pastoral value, but not exceeding the value of 1.5, which corresponds to weak-medium quality pastures.

CONCLUSIONS

The *Nardus stricta grasslands* , forming associations *Festuco rubrae – Nardetum strictae* Csürös et Resmeriţă 1960, respectively, *Violo declinatae – Nardetum* Simon 1966, studied in the northern Bihor Mountains, are important scientific point of view by the presence of rare, vulnerable, endemic species, previously described, which fully justifies their inclusion the European priority habitat 6230 * - Species-rich *Nardus grasslands*, in siliceous substrates in mountain areas, respectively, the Romanian classification (Doniţă et al., 2005), to R3608 and R3609 habitats.

The *Nardus stricta grasslands*, forming associations *Festuco rubrae – Nardetum strictae* Csürös et Resmeriţă 1960 , respectively, *Violo declinatae – Nardetum* Simon 1966, studied in the northern Bihor Mountains, are important scientific point of view by the presence of rare, vulnerable, endemic species, previously described, which fully justifies their inclusion the European priority habitat 6230 * - Species-rich *Nardus grasslands*, in siliceous substrates in mountain areas, respectively, the Romanian classification (Doniţă et al., 2005), to R3608 and R3609 habitats.

Although they are considered to be habitats of low conservation value, the presence of a significant percentage of species with large sozological value (11.53%) in the three associations as described, located in the Apuseni Natural Park, are strong arguments for the adoption of specific conservation measures. These measures should take into account the potential threats that can cause major disruptions the dynamic the balance of *Nardus grasslands*, that can be dependent on a rational grazing (Bărbos et Sima, 2008). The main potential threats to the stability of the *Nardus stricta* mountain pasture, which the authors mentioned have highlighted, are: overgrazing or undergrazing, abandoned pastures, deforestation, over sheep pen pasture, chemical and organic fertilization, tourism and recreational activities.

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