

CONTRIBUTIONS TO KNOWLEDGE OF CARPATHIAN BASOPHIL SPRUCE FORESTS IN THE NORTHERN PART OF THE BIHOR MOUNTAINS

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ABSTRACT. This paper presents phytocoenologic, ecological and eco-protective research made in the northern part of Bihor Mountains, in basophil spruce stands with *Doronicum columnae*. The phytocoenoses of the association *Doronicum columnae* - *Piceetum Coldea* 2002, assigned to regional Carpathian spruce forests sub-alliance *Soldanello majori* - *Picenion Coldea* 1991, have been identified in several calcareous forest stations at altitudes 850-1450 meters. The 15 phytocoenologic samplings made in the field and presented in the table include 155 species revealed. Among these, there are a number of endemic species (*Leucanthemum waldsteinii*, *Thymus comosus*, *Edraianthus graminifolius*), Carpathian endemisms (*Campanula rotundifolia* ssp. *polymorpha*, *Cardamine glanduligera*, *Symphytum cordatum*), rare species (*Carex brachystachys*, *Euonymus latifolius*, *Leucojum vernalis*, *Phyteuma spicatum*), one tertiary relict species (*Blechnum spicant*), vulnerable species (*Trollius europaeus*) which are on the the Red List.

Keywords: *Doronicum columnae* - *Piceetum*, life forms, floristic elements, ecological factors, the Red List

INTRODUCTION

Bihor Mountains represents the central orographic node of the Apuseni Mountains (Oancea et al., 1987). With an amplitude elevation between 800 meters and 1700 meters, these mountains have a strong fragmentation on a complicated assembly of calcareous rocks, karstifiable, bordered by non-karstifiable rocks (sandstone, shale purple, conglomerates). The Bihor Mountains climate 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 10°C. Prevailing wind is western, bringing of rain and causing a large number of cloudy days. Average annual rainfall in the highlands of Bihor Mountains exceed 1400 mm (Coldea et al., 2008).

Predominant vegetation in the northern part of Bihor Mountains according to physical-geographical and climatic conditionalities is the forest. Coniferous forest limit is between 900 - 1600 meters altitude, and the Aries basin down even to 700-800 meters, due to a cool climate on the background of frequent temperature inversions.

The association *Doronicum columnae* - *Piceetum Coldea* 2002, falling within sub-alliance **Soldanello majori** - **Picenion** Coldea 1991 (regional Carpathian sub-alliance for the spruce forests, Sanda et al. 2008) alliance **Piceion excelsae** Pawlowski in Pawlowski et al. 1928, order **PICEETALIA EXCELSAE** Pawlowski in Pawlowski et al. 1928, class **VACCINIO - PICEETEA** Br.-Bl. in Br.-Bl. et al. 1939 was described (Coldea, 2002,

Sanda et al. 2007) of Rodnei Mountains, Retezat Mountains, Piatra Craiului Mountains, Apuseni Mountains occupying small areas. The phytocoenoses of the association were identified within the analyzed area in the northern part of Bihor Mountains in 15 stations located at altitudes between 950-1450 meters. The basophil spruce stands from here occupy slopes, ridges, plateaus with various exhibitions, with the presence of the limestone substrate to the surface as the pillars, massive rocks, or coarse debris, where soils are shallow-middle deep, hydric balanced, brown eumesobasic, brown acid, rendzinic and peaty soils.

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 Boșcaiu (1965) to the features of the vegetation cover in our country. The phytocoenological relevés made during the 8 field study trips conducted during July 2010 to September 2011, included floristic and physiognomic homogenous sample, which were chosen in fragments characteristic surfaces of phytocoenoses studied, their size ranging between 400 and 800 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, complemented 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, number of the surveys, altitude (msm), exhibition, inclination (degrees), consistency stands (%), herbaceous layer (%), moss layer (%), area (sqm), place and the date of relevées. The constancy (K) and the average abundance-dominance (ADm) were calculated and introduced at the end of the table. To complete ecological study of the association we represented graphically the distribution of biological forms, floral elements, environmental factors and karyologic indexes.

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

RESULTS AND DISCUSSIONS

The phytocoenoses of the association (Table 1) includes a number of 116 plant species, of which 37 (31.9%) are of spruce stands, 36 taxa belong to beech forests of the class **QUERCO – FAGETEA**, 14 taxa belong to weeds developed along gills and to slippers places, specific the classes **BETULO – ADENOSTYLETEA**, **MOLINIO – ARRHENATHERETEA**, **GALIO – URTICETEA**, and a number of 12 species are specific to the rocks and screes of the class **ASPLENIETEA TRICHOMANIS**, **THLASPIETEA ROTUNDIFOLII**, **SESLERIETEA ALBICANTIS**.

The trees layer, with a consistency from 0.4 to 0.9, is dominated by spruce (*Picea abies*), with whom there is beech (*Fagus sylvatica*), sycamore maple (*Acer pseudoplatanus*), mountain ash (*Sorbus aucuparia*), rarely european fir (*Abies alba*). Multi-year spruce stands trees aged 70-150 years with heights exceeding 24-30 meters at diameter varying between 38-40 cm and 80-100 cm for spruce, while for beech the heights were recorded 7-20 meters at diameter from 12-20 cm to 40-60 cm. Seedlings and juvenile specimens are well represented, showing climax stage of these forests with high natural regeneration capacity. Shrub layer, weak overall, is composed of *Lonicera nigra*, *Daphne mezereum*, *Spiraea*

chamaedrifolia, *Rosa pendulina*, *Salix silesiaca*, *Corylus avellana*. The grasses and undershrub layer with variable coverage of 15-70%, are found acidophilous species specific the class (*Homogyne alpina*, *Luzula sylvatica*, *Calamagrostis villosa*, *Vaccinium myrtillus*, *Huperzia selago*, *Oxalis acetosella*) and species of mull flora (*Symphytum cordatum*, *Cardamine glanduligera*, *Mercurialis perennis*, *Asarum europaeum*, *Cardamine bulbifera*, *Geranium robertianum*, *Lilium martagon*, *Lathyrus vernus*, *Pulmonaria rubra*). An important representation have the saxicole species of the classes **ASPLENIETEA TRICHOMANIS**, **THLASPIETEA ROTUNDIFOLII**, **SESLERIETEA ALBICANTIS**: *Veronica urticifolia*, *Asplenium trichomanes* ssp. *quadrivalens*, *Asplenium viride*, *Moehringia muscosa*, *Cystopteris fragilis*). Among moisture-loving herbaceous species that are found in the association phytocoenoses, we mention: *Chaerophyllum hirsutum*, *Crepis paludosa*, *Aconitum vulparia*, *Trollius europaeus*, *Ranunculus repens*, *Geranium phaeum*, *Petasites hybridus*, *Telekia speciosa*, *Lunaria rediviva*, *Leucanthemum waldsteinii*, *Soldanella hungarica* ssp. *major*. The moss layer, here and there well developed, consists of species such as *Polytrichum strictum*, *Dicranum scoparium*, *Sphagnum girgensohnii*, *Mnium undulatum*, *Rhytidiadelphus triquetrus*, *Marchantia polymorpha*, *Hylocomium splendens*, *Ctenidium moluscum*.

The analysis of the diagram of the ecological factors (Fig. 1) result the prevalence of mesophilic species ($U_{3-3.5} = 63.8\%$), followed far away from the mesohygrophylous species ($U_{4-4.5} = 19.8\%$) and xeromesophylous species ($U_{2-2.5} = 12.1\%$). Analyzing the behavior towards temperature one can observe the dominance of microthermophilous species ($T_{2-2.5} = 43.1\%$) and mesothermophilous species ($T_{3-3.5} = 38.8\%$). Regarding the behavior to chemical reaction of the soil, most species are weakly acid-neutrophils ($R_{4-4.5} = 31\%$) and acid-neutrophils ($R_{3-3.5} = 27.6\%$).

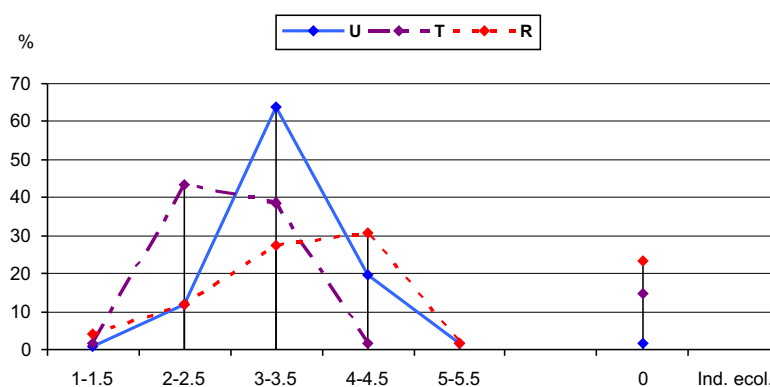


Fig. 1 Diagram of the ecological factors for the phytocoenoses in the ass. *Doronico columnae* – *Piceetum Coldea* 2002

The life forms spectrum (Fig. 2) for phytocoenoses of the association *Doronicum columnae* – *Piceetum Coldea* 2002 shows the dominance of hemicytrophites (H = 65.5%), followed far by geophytes (G = 14.6%) and phanerophytes (Ph = 12.9 %). High percentage of hemicytrophites is in accordance with the climate cold, temperate and with the soils with sufficient moisture in the

stations where the phytocoenoses of this association vegetate. The relatively high number of geophytes underlines extreme climate conditions, due to which they have adapted to short vegetation cycle period during ecological optimum spring. The low number of terophytes (Th-TH = 3.5%) indicates a low level of anthropic impact of these natural habitats.

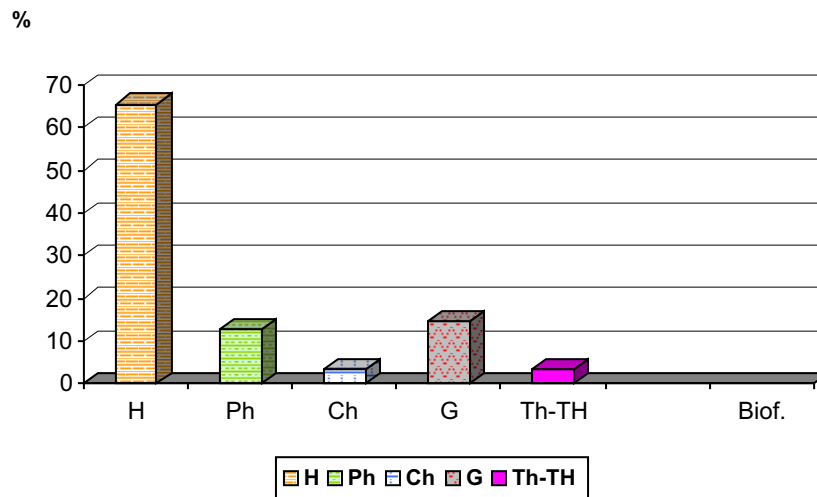


Fig. 2 Spectrum of life forms for the phytocoenoses in the ass. *Doronicum columnae* – *Piceetum Coldea* 2002

The spectrum analysis of floristic elements (Fig. 3) results the prevalence of continental and mountain species, with Eurasian (Eua = 23.2%), European (E = 21.5%) and Central European (Ec = 18.1%) origin. The circumpolar species have a good representation (Cp =

16.4%), emphasizing the origin of arctic-alpine, boreal species that have found optimum requirements for survival here. Relatively high number of Carpathian species (Carp, Carp, B, Alp-Carp = 12.9%) proves the Carpathian character of of this association.

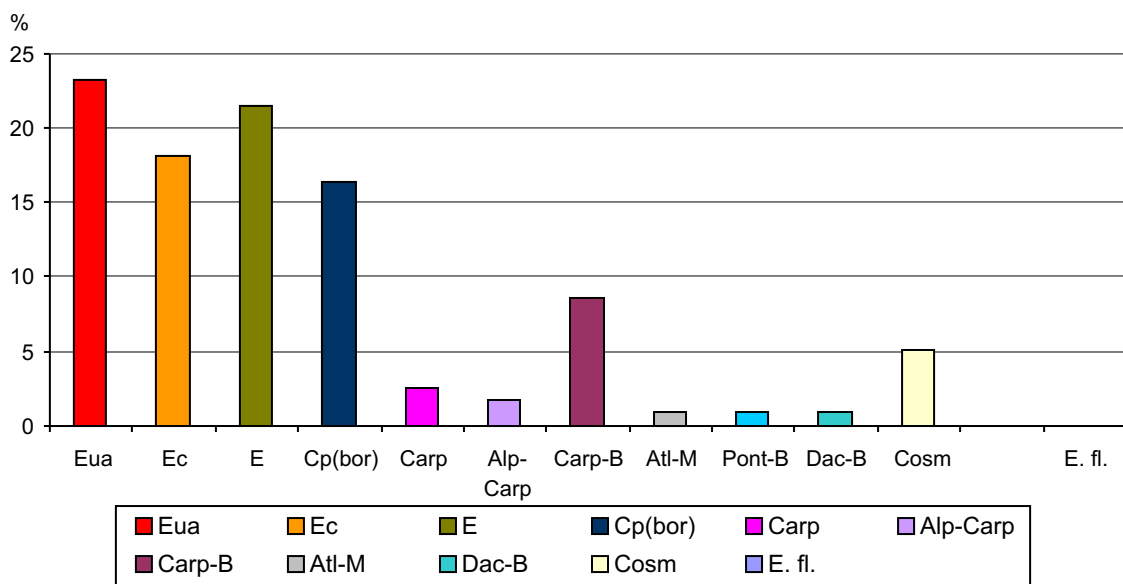


Fig. 3 Spectrum of the floristic elements for the phytocoenoses In the ass. *Doronicum columnae* – *Piceetum Coldea* 2002

The analysis of karyotypes present in the phytocoenoses of the association (Fig.4), reveals the dominance of diploid species (D = 41.4%) than those of

polyploidy (P = 40.5%). Diploids index is $I = \Sigma D / \Sigma P = 1.021$.

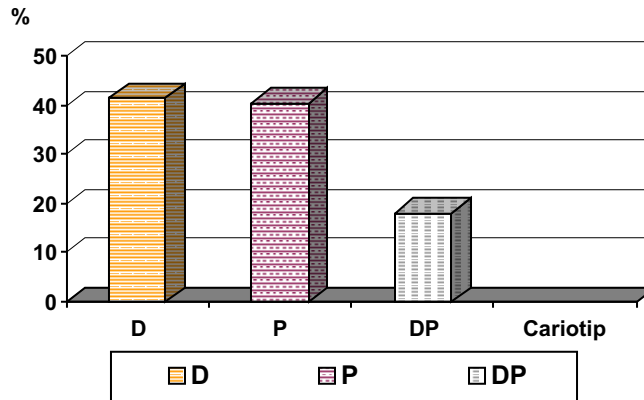


Fig. 4 Karyologic spectrum for the phytocoenoses in the ass *Doronico columnae – Piceetum Coldea* 2002

Tabel 1

Association *Doronico columnae – Piceetum Coldea* 2002

Life form	Floristic element	U	T	R	G	Nr. of survey															K	ADm		
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
						Altitude (m X10)	105	105	125	106	115	115	115	95	105	110	85	145	130	93	130			
						Exposure	N	E	SV	V	NE	E	S	SE	NV	V	SV	E	SV	SE	NE			
						Slope (°)	5	5	5	10	15	15	15	45	25	10	20	15	15	45	20			
						Consistency of trees	0.7	0.9	0.8	0.7	0.7	0.6	0.6	0.4	0.7	0.7	0.7	0.7	0.7	0.8	0.9			
						Height of trees (m)	24	20	28	30	20	24	22	18-20	24	22	26	22	26	20-24	20-24			
						Diameter of trees (cm)	38-60	26-28, 130	50-60, 100	50-70	50-60	40-50	70-80	36-38	100-120	60-80	48-50	60	40-60	30-60	30-60			
						Cover of bush layer (%)	30	5	1	20	5	2	5	2	20	10	2	2	25	10	1			
						Cover of grass layer (%)	30	65	25	45	35	35	60	35	60	15	70	60	60	40	50			
						Cover of moss layer (%)	80	30	5	20	5	25	20	10	1	-	40	20	40	40	25			
						Surface (x100 mp)	4	8	4	8	4	4	8	4	4	4	4	4	4	8	4			
Alp- H Carp- B		3.5	2	3.5	P	<i>Doronico columnae</i>	+	1	1	+	+	+	1	+	1	+	1	1	1	2	2	V	4.86	
MPh Eua		0	0	0	D	<i>Picea abies</i>	4	5	4	4	4	4	4	3	4	4	4	4	4	4	5	V	64.16	
Soldanello majori - Picenlon																								
H Carp		4	2	3	D	<i>Leucanthemum waldsteinii</i>	+	.	.	+	.	+	+	.	.	.	.	+	+	.	+	III	0.23
H B- Carp		3	0	0	D	<i>Hieracium transilvanicum</i>	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	II	0.13
Picelon excelsae																								
H E(alp)		3.5	2	5.2	5.2	P	<i>Homogyne alpina</i>	+	1	+	1	2	1	1	.	+	.	.	1	2	.	1	IV	4.43
H Ec		3.5	2	5.2	2	DP	<i>Luzula sylvatica</i>	+	+	+	+	+	+	1	.	+	.	.	+	1	+	1	IV	1.30
H Eua		4	2.5	1.5	P	<i>Calamagrostis villosa</i>	+	2	.	+	+	+	.	.	+	.	.	.	1	.	.	III	1.70	
H Ec (mont)		4	2	4	P	<i>Gentiana asclepiadea</i>	+	+	.	+	+	+	.	+	+	.	+	.	.	+	.	III	0.30	
G Cp (bor)		3.5	2	2	P	<i>Phegopteris connectilis</i>	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	II	0.13
H (nPh) Eua		3	2	2	D	<i>Clematis alpina</i>	+	.	I	0.07
H Cp (bor)		3.5	0	0	P	<i>Dryopteris dilatata</i>	.	.	+	.	+	+	.	I	0.10
H Ec		3	2.5	0	D	<i>Prenanthes purpurea</i>	.	+	.	+	I	0.07
Piceetalia excelsae																								
H(G) Eua		2.5	3	2	P	<i>Calamagrostis arundinacea</i>	3	.	.	+	I	2.53
H Cp(arc t-alp)		2	0	1	P	<i>Deschampsia flexuosa</i>	.	2	.	.	+	.	+	I	1.23
						<i>Sphagnum girgensohnii</i>	1	+	2	I	1.53
						<i>Pleurozium schreberi</i>	.	.	.	+	I	0.07
Athyrio - Piceetalia																								

Life form	Fl. El.	U	T	R	G	Nr. of survey	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K	ADm		
H	Cosm	4	2.5	0	DP	<i>Athyrium filix-femina</i>	+	+	+	+	+	+	+	.	2	+	+	+	.	.	+	IV	1.53		
nPh	Eua	3.5	3	3	D	<i>Daphne mezereum</i>	+	+	+	+	+	+	+	.	+	+	+	.	.	+	+	IV	0.40		
H	Eua	4	3	2	DP	<i>Hypericum maculatum</i>	+	+	+	+	+	.	+	.	+	.	+	+	.	.	+	IV	0.33		
nPh	Ec	3	2.5	3	P	<i>Rosa pendulina</i>	+	+	+	.	+	+	.	+	+	.	.	.	1	+	.	IV	0.63		
MPh	Ec	4	3	0	D	<i>Abies alba</i>	+	.	+	+	.	+	+	.	+	.	.	.	.	+	.	III	0.23
H-G	E	3.5	3	4	P	<i>Mercurialis perennis</i>	.	+	.	1	+	+	1	1	.	+	+	1	.	.	.	III	1.50		
H	Ec (mont)	3	0	4.5	D	<i>Valeriana tripteris</i>	.	+	.	.	.	+	+	.	+	+	.	.	+	+	+	III	0.26		
G	Eua	4	2.5	4	DP	<i>Veratrum album</i>	.	+	+	+	+	+	.	.	1	+	.	.	.	.	+	III	0.60
H	Eua	3	2.5	0	D	<i>Fragaria vesca</i>	+	.	.	.	.	+	.	.	+	.	.	+	+	.	+	II	0.20
G	Eua	3	0	4	D	<i>Lilium martagon</i>	.	+	+	+	+	II	0.13	
G	Cp (bor)	4	2	2	P	<i>Streptopus amplexifolius</i>	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	II	0.13
mPh	E	3	3	3	D	<i>Corylus avellana</i>	.	.	.	+	.	.	.	.	.	.	+	.	.	1	.	I	0.40
H	Ec (mont)	3.5	2.5	0	D	<i>Ranunculus platanifolius</i>	.	.	.	+	.	+	+	I	0.10	
H	Atl-M	3.5	3	4	D	<i>Sanicula europaea</i>	.	.	.	+	.	+	I	0.07	
Myrtillo - Piceetalia																									
H-G	Cp (bor)	4	3	3	DP	<i>Oxalis acetosella</i>	1	+	+	.	+	.	+	+	1	+	+	1	+	1	1	V	1.93		
H	Carp-B	3.5	2	3	D	<i>Pulmonaria rubra</i>	+	.	1	+	.	.	.	.	+	.	.	.	.	.	.	II	0.43
						<i>Dicranum scoparium</i>	+	1	1	2	1	2	.	+	.	.	2	+	+	+	.	IV	4.66		
						<i>Polytrichum strictum</i>	2	1	+	.	.	.	.	1	.	.	2	.	3	.	.	II	5.53
						<i>Mnium undulatum</i>	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	I	0.36
Vaccinio - Piceetea																									
Ch	Cosm	3.5	2	2	P	<i>Huperzia selago</i>	+	+	+	.	+	.	+	.	1	+	2	+	+	.	+	IV	1.80		
mPh	E (mont)	3	2	3	D	<i>Lonicera nigra</i>	2	.	+	+	+	+	1	.	2	1	+	+	2	.	+	IV	4.40		
MPh	E	3	2.5	2	D	<i>Sorbus aucuparia</i>	1	.	.	.	+	+	+	+	+	+	.	+	+	.	+	IV	0.63		
nPh	Cp (bor)	0	2	1	D	<i>Vaccinium myrtillus</i>	1	+	.	1	1	1	2	+	+	+	.	2	1	+	.	IV	4.16		
TH	Carp-B	3.5	2	2	P	<i>Campanula abietina</i>	.	+	.	.	+	+	.	.	.	.	.	+	+	.	.	II	0.17
G	Cp (bor)	4	0	1.5	P	<i>Listera cordata</i>	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I	0.07
H(G)	Cp (bor)	3	2	2.5	D	<i>Moneses uniflora</i>	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	I	0.10
						<i>Hylocomium splendens</i>	.	.	.	.	.	.	.	+	1	.	.	+	+	+	.	II	0.47
Asplenietea trichomanis																									
H	Ec (mont)	3	2.5	4	DP	<i>Veronica urticifolia</i>	+	+	+	+	+	+	+	+	+	+	+	+	IV	0.40	
H	Cosm	3	0	4	P	<i>Asplenium trichomanes ssp. quadrivalens</i>	.	.	.	.	+	+	+	.	.	.	+	+	.	+	.	III	0.23
H	Cp (bor)	4	2	4	D	<i>Asplenium viride</i>	+	.	+	+	.	.	+	+	.	.	.	+	+	+	+	III	0.30		
H	Ec (mont)	4	2	4	D	<i>Moehringia muscosa</i>	.	.	+	+	.	+	+	+	.	.	+	+	.	+	+	III	0.30		
H	Cp (bor)	1.5	3	5	P	<i>Asplenium ruta-muraria</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I	0.07
H	Alp-Carp-Pir	2.5	2	4.5	P	<i>Carex brachystachys</i>	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	I	0.07
H	E(alp)	2	1.5	0	DP	<i>Kernera saxatilis</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	I	0.07
G	Cp (bor)	3.5	3	4	P	<i>Polypodium vulgare</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	I	0.07
						<i>Ctenidium moluscum</i>	+	.	.	+	.	+	.	.	.	.	.	2	.	+	.	II	1.30
Thlaspietea rotundifolii																									
H	Cosm	3.5	0	0	P	<i>Cystopteris fragilis</i>	+	.	.	.	.	+	.	+	+	.	.	+	+	+	+	III	0.26
G	Cp (bor)	3	2.5	4.5	P	<i>Gymnocarpium robertianum</i>	.	.	.	+	.	+	.	.	.	.	.	.	.	.	+	I	0.10
Seslerietea albicantis																									
H	Carp-B	2.5	2	4.5	P	<i>Sesleria rigida</i>	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	I	0.37
Ch	Carp	2	3.5	4.5	D	<i>Thymus comosus</i>	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	I	0.10
Betulo - Adenostyletea																									
G	E	3	2.5	2.5	D	<i>Polygonatum verticillatum</i>	+	+	+	+	+	+	1	+	+	+	.	1	+	.	+	V	1.03		
H	Ec	4	2.5	4	D	<i>Aconitum vulparia</i>	+	+	.	+	.	.	.	+	.	+	+	+	III	0.23	

Life form	Fl. El.	U	T	R	G	Nr. of survey	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K	ADm	
H	Eua	3.5	3	3	DP	<i>Myosotis sylvatica</i>	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	III	0.30
H	Ec	4.5	2	0	D	<i>Chaerophyllum hirsutum</i>	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	II	0.17
H	E (mont)	3.5	2	0	D	<i>Cicerbita alpina</i>	.	+	+	.	.	.	+	.	+	.	.	.	.	.	.	II	0.13
H	E(alp)	2.5	1.5	1.5	P	<i>Geum montanum</i>	+	+	.	1	.	+	.	.	+	+	.	.	.	.	.	II	0.50
H	Cp (bor)	3.5	3	3	DP	<i>Milium effusum</i>	+	.	.	.	.	+	+	+	+	.	.	+	.	.	.	II	0.20
H(G)	Carp-B	3.5	2	0	D	<i>Adenostyles alliaria</i>	+	.	+	I	0.07
H	Cp	3.5	2	4	D	<i>Viola biflora</i>	+	.	+	+	I	0.10
Mollnio - Arrhenatheretea																								
H	Eua	2.5	3	0	DP	<i>Filipendula ulmaria</i>	+	.	.	+	.	+	.	.	+	.	.	+	+	.	.	II	0.20	
H	E	5	3	0	P	<i>Caltha palustris</i> ssp. <i>laeta</i>	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	I	0.37
H	Ec	4	3.5	0	D	<i>Cirsium rivulare</i>	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	I	0.07
H	E	4.5	0	4.5	DP	<i>Crepis paludosa</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	I	0.07
H	Eua (M)	4	0	0	P	<i>Ranunculus repens</i>	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I	0.10
H	E(bor)	4	2	4	D	<i>Trolium europaeus</i>	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I	0.10
Galio - Urticetea																								
H	Eua	5	3	3	P	<i>Petasites hybridus</i>	+	.	.	+	.	+	.	.	+	+	.	.	.	.	.	II	0.17
H	Ec	4	3	3	DP	<i>Geranium phaeum</i>	+	+	I	0.07
H	Carp-B-Cau	4	2	0	D	<i>Telekia speciosa</i>	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I	0.07
H-G	Cosm	3	3	4	DP	<i>Urtica dioica</i>	+	+	+	I	0.10
Epilobietea angustifolii																								
nPh	Cp (bor)	3	3	3	DP	<i>Rubus idaeus</i>	+	+	.	+	.	+	.	+	+	.	.	+	+	+	+	+	III	0.30
nPh	E	3	2.5	3	P	<i>Rubus hirtus</i>	.	+	1	.	1	.	+	.	+	+	+	.	.	.	.	III	0.83
mPh	Eua	3	2.5	0	P	<i>Spiraea chamaedrifolia</i>	1	1	.	+	.	+	.	+	+	.	+	.	+	.	+	III	0.87	
H	Eua	3.5	3	3	P	<i>Senecio germanicus</i>	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	I	0.10
Quercu - Fagetea																								
MPh	E	3	3	0	D	<i>Fagus sylvatica</i>	+	.	2	1	1	+	+	.	1	+	1	1	1	2	+	V	4.50	
G	Carp	4	2.5	4	P	<i>Cardamine glanduligera</i>	+	+	+	.	.	+	+	+	+	.	.	.	+	+	+	IV	0.33	
H	Eua	3.5	0	4	P	<i>Paris quadrifolia</i>	+	+	.	+	.	+	+	+	+	.	.	+	+	.	+	IV	0.33	
H-G	Carp-B	3	2	3	D	<i>Symphytum cordatum</i>	+	+	+	1	.	+	+	+	1	+	.	.	+	+	+	IV	1.00	
MPh	Ec	3.5	3	3	P	<i>Acer pseudoplatanus</i>	+	.	.	.	+	+	+	+	+	1	.	+	.	+	.	III	0.60	
G	E	3.5	4	0	P	<i>Anemone nemorosa</i>	+	.	.	+	.	+	+	.	+	+	.	.	+	.	.	III	0.23	
H	Ec	3	2.5	3.5	D	<i>Aposeris foetida</i>	.	.	.	+	+	.	+	.	+	.	+	+	+	+	+	III	0.26	
H	E	3.5	3	4	P	<i>Carex sylvatica</i>	.	+	.	+	+	+	.	+	.	+	.	+	.	.	.	III	0.23	
Ch	E(M)	3	3.5	4	DP	<i>Euphorbia amygdaloides</i>	.	.	.	.	+	+	.	.	.	.	.	+	+	+	+	III	0.23
G	Cp (bor)	3	2.5	2	P	<i>Gymnocarpium dryopteris</i>	+	+	.	+	.	+	.	1	1	.	+	.	+	.	+	III	0.90	
H	E (mont)	3.5	3.5	3.5	P	<i>Polystichum aculeatum</i>	+	+	+	+	.	.	+	+	.	+	III	0.23
H	Carp-B	2.5	2.5	4.5	P	<i>Aconitum firmum</i>	.	.	.	.	.	+	+	+	.	.	.	.	+	+	.	II	0.17
H-G	Eua	3.5	3	4	DP	<i>Asarum europaeum</i>	.	+	+	+	+	.	.	.	.	.	1	.	.	+	.	II	0.50
H	Ec (mont)	3.5	2	3	P	<i>Doronicum austriacum</i>	+	+	+	+	+	+	II	0.20
H	Eua (M)	3	0	3.5	P	<i>Epilobium montanum</i>	+	+	+	+	.	II	0.13
H	Ec (mont)	3	4	4	D	<i>Euphorbia camiolica</i>	.	+	+	+	II	0.13
G	E	3	3	4	D	<i>Hepatica nobilis</i>	+	+	+	.	II	0.13
H	Ec	3	0	4	D	<i>Lamium galeobdolon</i>	+	.	.	+	.	+	+	.	.	.	+	+	II	0.20
(Ch)	Eua	3	3	3	D	<i>Lathyrus vernus</i>	.	+	.	+	+	+	.	+	.	.	.	.	.	.	.	II	0.20
G	Eua (bor)	3	3	0	P	<i>Maianthemum bifolium</i>	.	+	.	.	.	+	+	+	.	.	.	.	+	+	.	II	0.20
H	E	3	3	0	D	<i>Mycelis muralis</i>	.	.	+	.	.	+	+	.	.	.	.	.	.	+	.	II	0.13
H	Eua	3	3	4	DP	<i>Primula elatior</i> ssp. <i>elatior</i>	.	.	.	.	+	.	.	.	+	.	.	+	+	.	.	II	0.13
H	E	3.5	3	3	DP	<i>Stellaria nemorum</i>	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	II	0.13
H	Eua	3.5	3	3	D	<i>Actaea spicata</i>	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	I	0.10
G	Cp (bor)	3.5	3	5	D	<i>Asplenium scolopendrium</i>	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	I	0.07
H	E(M)	3	2	0	DP	<i>Campanula rapunculoides</i>	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	I	0.10
G	Ec	3	3	4	P	<i>Cardamine bulbifera</i>	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	I	0.07
G	Eua	3	3	3	P	<i>Galium odoratum</i>	+	+	1	.	.	.	.	.	.	.	.	.	+	.	.	I	0.43
G	Ec	2.5	3	3	P	<i>Galium schultzeii</i>	+	.	.	+	+	.	I	0.10

Life form	Fl. El.	U	T	R	G	Nr. of survey	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K	ADm								
Th	Cosm	3.5	3	3	P	<i>Geranium robertianum</i>	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	I	0.10
H (Ch)	E	3.5	0	4	D	<i>Lamium maculatum</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	I	0.07
H-G	Eua (M)	3	0	4	D	<i>Melica nutans</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	I	0.07
H	Eua	3	3	0	DP	<i>Poa nemoralis</i>	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	I	0.07
H	Cp (bor)	3.5	2.5	3	P	<i>Polystichum braunii</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	I	0.10
Ch	Ec (mont)	3.5	2	0	DP	<i>Saxifraga rotundifolia</i>	+	+	+	I	0.10						
mPh	-	Eua	4	3	3	P	<i>Ulmus glabra</i>	.	.	.	+	.	+	I	0.07						
MPh						Variae syntax																									
mPh	Carp-B Sudet	4	2	2	D	<i>Salix silesiaca</i>	1	+	.	2	.	+	.	+	+	+	.	.	+	.	.	.	III	1.70							
H-Ch	E	3.5	0	0	D	<i>Ajuga reptans</i>	+	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	II	0.13
TH-H	Ec	2.5	3	4	P	<i>Cardaminopsis arenosa</i>	.	.	.	.	.	.	.	+	.	.	+	+	.	+	+	.	II	0.17
G	Eua (M)	2	3	4	D	<i>Polygonatum odoratum</i>	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.	.	II	0.13
H	Cp (bor)	2.5	3	3	D	<i>Solidago virgaurea</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	II	0.13
H	Pont-B	3	2.5	3.5	D	<i>Aconitum lycoctonum</i>	+	+	I	0.07						
H	Carp-B-Pan	2.5	3	4	P	<i>Helleborus purpurascens</i>	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I	0.07
TH-H	Dac-B	3	2	3	D	<i>Verbascum lanatum</i>	+	+	.	I	0.07						
						<i>ssp. hinkei</i>	I	0.07						
						<i>Rhytidiadelphus triquetrus</i>	3	2	.	.	.	+	.	.	.	.	+	+	.	+	.	.	II	3.80			
						<i>Marchantia polymorpha</i>	2	.	.	+	+	I	1.23						

Place and date of the relevees: 1. Peștera Barsa, 05.07.2010; 2. Tăul Negru din Barsa, 05.07.2010; 3. Calciș, 05.07.2010; 4. Zăpodie, 05.07.2010; 5. Valea Galbenei, 30.08.2010; 6. Valea Cetăților, 02.09.2010; 7. Barsa Cohanului, 08.06.2011; 8. Cetățile Ponorului, 9. Cetățile Ponorului, 08.06.2011; 10. Hornul Cetăților, 08.06.2011; 11. Cheile Galbenei, 10.08.2011; 12. Biserica Moțului, 13. Cetățile Rădesei, 25.08.2011; 14. Zgurăști, 30.08.2011; 15. Cheile Someșului Cald, 03.09.2011.

Species in one single relevee: (3, +) *Galium pumilum*; (8, +) *Arabis alpina*, *Campanula rotundifolia* ssp. *polymorpha*, *Potentilla thuringiaca*, *Pulmonaria officinalis*, *Silene nutans* ssp. *dubia*; (9,+) *Lathraea squamaria*, *Leucojum vernum*; (10, +) *Geum rivale*, *Lathyrus hallersteinii*; (11,+) *Lunaria rediviva*; (12,+) *Glechoma hederacea*, *Leontodon hispidus*, *Rumex acetosa*, *Stachys sylvatica*; (13, +) *Brachypodium sylvaticum*, *Polystichum lonchitis*, *Soldanella hungarica* ssp. *major*; *Thesium alpinum*; (14, +) *Aconitum anthora*, *Asperula odorata*, *Carex digitata*, *C. transsilvanica*, *Cirsium erisithales*, *Digitalis grandiflora*, *Edrajanthus graminifolius*, *Euonymus latifolia*, *E. verrucosa* ssp. *polymorpha*, *Hieracium murorum*, *Laserpitium latifolium*, *Lonicera xilostemum*, *Melampyrum sylvaticum*, *Phyteuma spicatum*, *Ribes alpinum*, *Rhamnus saxatilis* ssp. *tinctorius*, *Rubus saxatilis*, *Scabiosa columbaria*, *Sedum telephium*, *Apometzgeria pubescens*, *Brachytecium rutabulum*, *Hypnum cupressiforme*, *Polytrichum commune*; (15, +) *Blechnum spicant*.

CONCLUSIONS

Compared to the data collected by Coldea (2002), the phytocoenoses of the association *Doronico columnae* – *Piceetum Coldea* 2002 revealed the northern part of Bihor Mountains is characterized by the presence of numerous hemicryptophytes (65.5% versus 55.1% of relevees made by Coldea the Apuseni Mountains, Rodnei Mountains, and Piatra Craiului Mountains) and geophytes (14.6% vs. 12.2%), rather phanerophytes (12.9% in the Bihor Mountains, to 15.3%), chamaephytes (3, 5% to 11.3%) and terophytes (3.5% versus 6.1%). This can be explained by specific physical and geographical requirements, the substrate and microclimate from the northern part of Bihor Mountains.

The dominance of European and Central European species (39.6% by part of Bihor Mountains, compared to 40% to Coldea, 2002), illustrated in the two tables of the association, highlights the European, mountainous character of the basophil spruce stands forming the association *Doronico columnae* – *Piceetum Coldea* 2002.

Calculating K_a altitude index with method developed by Pop et Dragulescu, 1983 (in Cristea et al., 2004) the formula $K_a = T / H \times 100$, where T = number of terophytes, H = number of hemicryptophytes, shows an value of this index of 5.26%, which confirms the quartering of this association in habitats with cool climate with low anthropogenic influence.

The association *Doronico columnae* – *Piceetum Coldea* 2002 was included (Doniță et al., 2005) to R4213

habitat - South East Carpathian Spruce Forest (*Picea abies*) with *Doronicum columnae*, with moderate conservative value. This habitat hosts a number of species on the Red List (Boşcaiu et al., 1994, Dihoru et Negrean, 2009), such as endemic species (*Leucanthemum waldsteinii*, *Thymus comosus*, *Edraianthus graminifolius*) Carpathian endemisms (*Campanula rotundifolia* ssp *polymorpha*, *Cardamine glanduligera*, *Symphytum cordatum*), rare species (*Carex brachystachys*, *Euonymus latifolius*, *Leucojum vernalis*, *Phyteuma spicatum*), a tertiary relict species (*Blechnum spicant*), vulnerable species (*Trolius europaeus*).

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