CONTRIBUTIONS TO THE KNOWLEDGE OF JUNIPERUS SCRUBS FROM APUSENI MOUNTAINS, ROMANIA

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Abstract

This paper presents the phytocoenologic research of the juniper scrub developed on acidic soils from Apuseni Mountains, the Northern part of the Bihor Mountains, Romania. The phytocoenosis of the association Vaccinio – Juniperetum communis Kovács 1979, less described in Romania, were identified over large areas in the northern part of Bihor Mountains in several localities on the Massif Măgura Vânâtâ, in the saddle Vărăşoaia - Piatra Arsă – Cumpănăţelu and the saddle Oşelu. The association included in the habitat R3108 - Southeast Carpathian dwarf juniper scrub, which requires the designation of Special Areas of Conservation, is characterized by the presence of some protected species, including: Arnica montana, Campanula patula ssp.abietina, Campanula serrata.

The association Vaccinio – Juniperetum communis Kovács 1979, was analyzed in terms of life forms spectrum, floristic elements spectrum, ecological indices (humidity, temperature, chemical reaction of soil) and karytype. In the association table a number of 10 relevées have been recorded and analyzed, including 43 taxons.

Key words: *Taxo-Fagetum*, life forms, floristic elements, ecological indices, Special Areas of Conservation.

INTRODUCTION

The Bihor Mountains form the central axis of the Apuseni Mountains, within the Romanian Carpathians (Pop, 2006). These mountains represents, from geological terms, a complex structure, in which the calcareous substrates stand out in the central plateau surrounded by massive crystalline rocks , acidic, with high elevations over 1600 m altitude in the northern part (Bleahu, 1981). The average annual temperature of 2˚C and average annual rainfall of over 1400 mm, specific to higher mountains, due to positioning the Bihor Mountains, here is discharged most of the moisture brought by the winds from the west, more humid. The climatic conditions favors the forest vegetation extended over large areas.

The juniper scrubs from the northern part of the Bihor Mountains, are developed at the upper limit of mountain level (1200-1600), in the forests' glades, and secondary, over large areas, replacing the spruce forests grubbed up in the last centuries.

The association *Vaccinio – Juniperetum communis* Kovács 1979 was

described in Romania from Bodoc Mountains (Kovács, 1979), Maramureşului Mountains (Resmeriță, 1982) and Suhard Mountain (Costică et al., 2010).

MATERIAL AND METHODS

The association *Vaccinio – Juniperetum communis* Kovács 1979 was framed (Sanda et al., 2008) in the following coeno-system at the alliance and order of acidophilous, oligotroph juniper scrubs from subalpine level, the class of coniferous forests and scrubs:

VACCINIO – PICEETEA Br.-Bl. in Br.-Bl. et al. 1939

VACCINIO – JUNIPERETALIA Passarge et Hoffmann 1968

Vaccinio – Juniperion communis Passarge et Hoffmann 1968

During the field observations and research, we have used methods of phytosociological research of the Central-European School, based on the principles and methodologies developed by Braun-Blanquet (1928) and adapted by Borza (1934), Borza et Boşcaiu (1965) to the particularities of the vegetation layer in our country. The phytocoenological surveys done during the field trips organized between July 2011 – July 2013 comprised sample surfaces that were homogenous from a floristic and physiognomic point of view, which were chosen in the fragments characteristic to the researched phytocoenoses, from 400 to 800 sqm.

The quantitative appreciation of each species' participation in the description of the associations has been done by means of the abundance-dominance index (AD), by the Braun-Blanquet et Pavillard (1928) evaluation system, completed by Tüxen et Ellenberg (1937). The association table elaborated according to the indications provided by Cristea et al. (2004), contains information regarding the species that make the floristic composition of the association, the life forms, the floristic elements, ecological indexes (humidity, temperature, the chemical soil reaction), the karyologic index, the recorded number of the survey, the altitude (m.s.m.), the exposure, inclination (degrees), the trees' consistency (%), the grassy layer (%), the moss layer (%), the surface (sqm), the place and date of the surveying. The constancy (K) and the average abundance-dominance (ADm) were calculated and introduced at the end of the table. In order to bring the ecological study of the association to a whole, we have represented graphically the distribution of biological forms, of floristic elements, of ecologic factors and karyologic indexes.

The botanical nomenclature used is the one developed for Romanian flora by Ciocârlan (2009).

RESULTS AND DISCUSSION

The phytocoenosis of juniper with blueberry association occupies hundreds of hectares in the upper half of the mountain slopes and plateau Măgura Vânătă massif, atop Vărăşoaia - Cumpănăţelu - Piatra Arsă and the half average peak Oşelu, at altitudes between 1210-1600 m, at least to strongly inclined slopes with southern or eastern predominantly exhibition. The phytocoenosis of the Association are stationed on the brown podzolic soils, humic-silicate, rich in rock fragments, on slopes heavily fixed screes . The soil, superficial generally, have an acidic to strongly acidic chemical reaction. The shrubs with a height of 1-2 m form small groups in glades of the spruce forest or compact groups with large areas of spruce forest overhead. The shrub layer coverage is 65-80%, and the herbaceous layer reach only 10-40% coverage. The bryophytes layer is variable and may reach 20-25% coverage. It is worth noting the sporadic presence of young spruce (Picea abies), with low heights of 3-4 m; that indicates the evolution of that association to *Vaccinio – Piceetum*, phytocoenosis that will provide the climax stage.

In terms of floristic composition, the association *Vaccinio – Juniperetum communis* Kovács 1979 from the northern part of Bihor Mountains include 43 taxa (Table 1). The shrub layer includes characteristic and dominant species *Juniperus communis* var.*intermedia* and *Vaccinium myrtillus*, with a maximum constancies (K = V) and a high abundance-mean dominance (ADm). The herbaceous layer with coverage between 10-40% is composed of many species subordinated the order **Vaccinio - Juniperetalia** (*Campanula patula ssp.abietina, Deschampsia flexuosa, Calamagrostis arundinacea, Luzula luzuloides, Potentilla aurea ssp.chrysocraspeda, Soldanella hungarica ssp.major, Senecio nemorensis var.germanicus, Crocus vernus, Rumex arifolius)* and class **VACCINIO – PICEETEA** (*Vaccinium vitis-idaea, Homogyne alpina, Luzula sylvatica, Oxalis acetosella, Gentiana asclepiadaea, Melampyrum sylvaticum*). Along with these, in the phytocoenoses of the association also have penetrated transgressive species belonging to the class **NARDO – CALLUNETEA** (*Nardus stricta, Festuca nigrescens, Viola declinata, Campanula serrata, Hypericum maculatum, Arnica montana, Antennaria dioica*), class **EPILOBIETEA** (*Rubus idaeus, Digitalis grandiflora*) and class **QUERCO – FAGETEA** (*Epilobium montanum, Campanula persicifolia, Fragaria vesca, Veronica officinalis*). A total of 9 accidental or incidental species were identified in the relevées carried out, occurring in neighboring coenotic groups, were brought by wind or animals or representing remnants of the evolution stages of phytocoenoses.

Table 1

Association *Vaccinio – Juniperetum communis* Kovács 1979

Life form	Flor.elem.	U	T	R	G	Nr.relevee	1	2	3	4	5	6	7	8	9	10	K	ADm
						Altitude (m)	1210	1430	1550	1580	1600	1580	1550	1520	1600	1580		
						Expozition	S	S	SE	E	SV	V	S	SE	E	NE		
						Slope (°)	20	10	25	18	5	10	40	30	10	30		
						Shrub layer coverage (%)	65	80	80	80	75	75	85	80	70	80		
						Grass layer coverage (%)	15	40	15	10	30	25	10	15	15	10		
						Bryophyte layer coverage (%)	15	-	-	-	20	-	-	-	10	5		
						Surface (sqm)	100	100	100	100	100	100	100	100	100	100		
mPh	Cp-Bo	2	0	0	D	*Juniperus communis*	3	4	4	4	3	3	4	4	4	4	V	55.00
nPh(Ch)	Cp-Bo	0	2	1	D	*Vaccinium myrtillus*	3	2	2	1	3	3	2	2	1	2	V	21.00
						Vaccinio-Juniperetalia												
TH	Carp-B	3.5	2	2	P	*Campanula patula ssp.abietina*	.	+	+	+	+	+	+	+	.	+	IV	0.40
H	Cp-A-a	2	0	1	P	*Deschampsia flexuosa*	+	2	1	+	+	.	.	1	+	+	IV	3.00
H	Eua(cont)	2	3	2	P	*Calamagrostis arundinacea*	.	.	+	.	+	.	.	+	+	+	III	0.25
H	E	2.5	2.5	2	DP	*Luzula luzuloides*	.	.	+	+	+	.	+	+	+	.	III	0.30
H	Carp-B	0	1.5	2	N	*Potentilla aurea ssp.chrysocraspeda*	.	+	.	.	+	+	.	+	.	+	III	0.25
H	Alp-Carp	4	2	1.5	P	*Soldanella hungarica ssp.major*	.	.	+	+	+	+	.	+	.	.	III	0.25
H	Eua	3.5	3	3	P	*Senecio nemorensis var.germanicus*	.	+	.	+	+	.	+	.	.	.	II	0.20
G	Carp-B	3	1	2	DP	*Crocus vernus*	+	.	.	.	+	.	.	.	.	.	I	0.10
H	Eua	3.5	2	3.5	D	*Rumex arifolius*	.	.	.	.	.	+	+	.	.	.	I	0.10
						Vaccinio-Piceetea												
Ch-nPh	Cp-Bo	3	2	1	D	*Vaccinium vitis-idaea*	1	+	+	+	1	+	+	.	1	1	V	2.25
MPh	E	0	0	0	D	*Picea abies juv.*	+	.	.	+	+	.	.	.	+	+	III	0.25
H	E(Alp)	3.5	2.5	2.5	P	*Homogyne alpina*	.	.	+	.	+	.	.	+	.	+	II	0.20
H	EC	3.5	2.5	2	DP	*Luzula sylvatica*	+	.	.	+	.	+	.	.	.	.	II	0.15
H(G)	Cp-Bo	4	3	3	DP	*Oxalis acetosella*	+	.	.	.	+	+	.	.	.	.	II	0.15
H	EC	4	2	4	P	*Gentiana asclepiadaea*	+	.	.	.	+	.	.	.	.	.	I	0.10
Th	Eua(mont)	3	0	1.5	D	*Melampyrum sylvaticum*	.	.	.	.	.	+	.	.	+	.	I	0.10
						Cynosurion et Nardo-Callunetea												
H	Eua(Cp)	0	0	1.5	D	*Nardus stricta*	+	2	+	.	2	2	1	+	+	.	IV	5.95
H	E	3	1	2	P	*Festuca nigrescens*	.	.	1	.	+	+	.	.	+	+	III	0.70
H	Cp-Bo	3	0	0	P	*Festuca rubra*	1	+	+	+	+	.	.	.	.	.	III	0.70
H	Carp-B	3.5	2	2	DP	*Viola declinata*	+	.	+	+	.	.	+	+	.	.	III	0.25
H	Carp-B	0	2.5	0	DP	*Campanula serrata*	.	.	.	+	+	.	.	+	.	.	II	0.15

Continuation Table 1

Life form	Flor.elem.	U	T	R	G	Nr.relevee	1	2	3	4	5	6	7	8	9	10	K	ADm
H	Eua	4	3	2	DP	*Hypericum maculatum*	+	.	+	+	.	.	.	.	.	.	II	0.15
H	Cp-Bo	0	0	0	P	*Agrostis capillaris*	+	+	.	.	.	.	.	.	.	.	I	0.10
H	E	3	2.5	3	P	*Arnica montana*	.	.	.	+	.	.	+	.	.	.	I	0.10
H	EC(M)	2.5	0	0	D	*Carlina acaulis*	+	+	.	.	.	.	.	.	.	.	I	0.10
H	Eua	0	0	0	P	*Potentilla erecta*	+	.	.	+	.	.	.	.	.	.	I	0.10
						Epilobietea												
nPh	Cp-Bo	3	3	3	DP	*Rubus idaeus*	.	+	.	+	.	.	1	.	.	.	II	0.60
H	EC	2.5	3	3	P	*Digitalis grandiflora*	.	.	.	.	.	.	+	+	.	.	I	0.10
						Querco-Fagetea												
H	Eua	3	0	3.5	P	*Epilobium montanum*	.	+	.	+	+	.	.	+	.	.	II	0.20
H	Eua	3	3	0	D	*Campanula persicifolia*	+	.	.	.	.	+	.	.	.	.	I	0.10
H	Eua	3	2.5	0	D	*Fragaria vesca*	+	.	.	.	+	.	.	.	.	.	I	0.10
Ch	Eua	2	2	2	P	*Veronica officinalis*	.	.	.	.	+	+	.	.	.	.	I	0.10
						Variae syntaxa												
H	EC	0	0	3	D	*Laserpitium krapfii*	.	.	.	+	+	.	+	+	+	+	III	0.30
H	Eua	0	2	2	P	*Luzula sudetica*	.	+	.	.	+	.	+	+	+	.	III	0.25
H	E(Alp)	2.5	1.5	4	P	*Carex sempervirens*	.	.	+	.	.	.	.	+	.	.	I	0.10
H	Eua	0	3	0	P	*Carex spicata*	.	+	.	.	.	.	.	+	.	.	I	0.10
Th	EC	3	3	0	N	*Euphrasia stricta*	+	.	.	.	.	+	.	.	.	.	I	0.10
H	Carp-B	3	1.5	2	P	*Hieracium atratum ssp.subnigrescens*	.	.	.	.	.	.	.	.	+	+	I	0.10
H	Alp-Carp	3	2.5	2	DP	*Hypochaeris uniflora*	.	.	.	.	.	+	.	+	.	.	I	0.10
H	Cp-A-a	3	2	0	P	*Phleum alpinum*	.	.	.	.	.	.	+	+	.	.	I	0.10
H(Ch)	Eua	3	3	4	D	*Silene vulgaris*	.	.	.	.	.	.	.	.	1	+	I	0.55
						Dicranum scoparium	2	.	.	.	1	.	.	.	+	.		
						Polytrichum communis	+	.	.	.	+	.	.	.	1	.		
						Polytrichum juniperinum	.	.	.	.	2	.	.	.	.	.		
						Pleurozium schreberi	+	.	.	.	.	.	.	.	.	.		

Place and date of the relevees: 1- 15.07.2011, Oşelu; 2,3- 04.08.2011, Şaua Cumpănățelu; 4- 04.08.2011, Piatra Arsă; 5,6- 10.09.2011, Măgura Vânătă; 7,8- 10.07.2012, Coasta Brăiesei; 9,10- 07.07.2013, Măgura Vânătă. Species that occur in a single relevee: 1- *Campanula patula, Gentianopsis ciliata, Helleborus purpurascens, Primula verris, Prunella vulgaris, Thymus glabrescens, Veratrum album, Veronica chamaedrys; 2- Rubus hirtus; 4- Thymus balcanus; 6- Calamagrostis villosa, Hieracium transsylvanicum; 9- Hieracium peterfii; 10- Calluna vulgaris.*

The phytocoenoses of the association accommodating a number of protected species (Dihoru, Negrean, 2009; Boşcaiu et al., 1994), including: the Carpathian endemic *Campanula serrata*, the vulnerable species *Arnica montana,* the rare species (DD) *Campanula patula ssp.abietina*.

In the life forms spectrum (Fig. 1) predominates the hemicryptophytes (H=77,5%), followed by phanerophytes (Ph=10%, from which mega-phanerophytes MPh=2,5%, mezo-phanerophytes mPh=5%, nano-phanerophytes nPh=2,5%), chamaephytes (Ch=5%) and geophytes (G=2,5%), both types proving the difficult climate conditions on the southern exhibition rocks, and finally, terophytes (T=5%, annual Th=2,5%, biennial TH =2,5%) with a poor percentage, illustrate a low anthropic impact on flora and vegetation.

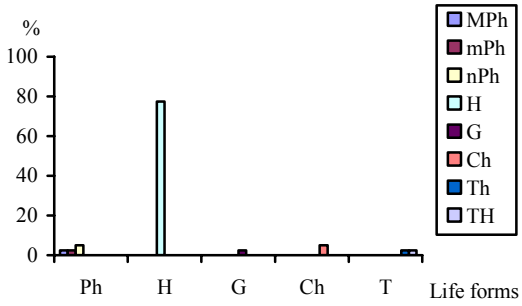

Fig. 1. The life forms spectrum of ass. *Vaccinio – Juniperetum communis* Kovács 1979

The participation of floristic elements in the composition of the floristic elements spectrum (Fig.2) we notice a high diversity of origin of the phytocoenoses species, predominantly Eurasian species (Eua = 30%), followed by Circumpolar species (Cp = 22,5%, from which Circumpolar-boreal Cp-Bo = 17,5% and Circumpolar-Arctic-alpine Cp-A-a = 5%), European and Central European ones (E = EC = 15%), the Carpathian species (Carp) totaling 12,5% and the Alpine-Carpathian species (5%).

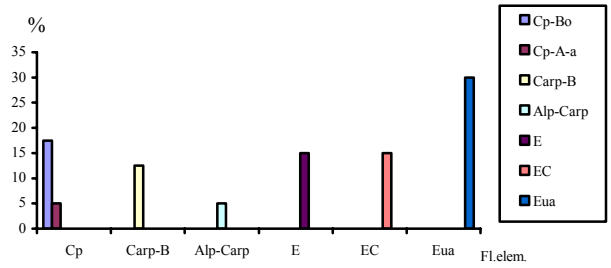

Fig. 2. Spectrum of floristic elements of ass. *Vaccinio – Juniperetum communis* Kovács 1979

Analyzing the behavior of phytocoenoses species to the three environmental factors (humidity, temperature, chemical reaction of the soil - Fig.3), we observe the predominance of mesophylous species (U_3=30%, $U_{3,5}$=15%) according with dry-moist soil to moist soil, wet enough, of the localities where are stationed the phytocoenoses of the association. The amphitolerant species (U_0) are 25% and the other types (U_2, $U_{2,5}$, U_4) are each 10%. The microthermophilous species (T_2=25%, $T_{2,5}$=30%) are predominant, followed by the micro-mezothermophilous species (T_3=22,5%), showing average annual temperature specific the high mountain stage, with conifers stationed on rocky soil. Response to chemical soil reaction, having a pH reaction between 3,8-6,5, the acidophilous (R_2=32,5%) and the acid-neutrophilous (R_3=20%) species predominates, followed closely by the strongly acidophilous ones (R_1= 12,5%). The association includes an important group of amphitolerant species (R_0=30%).

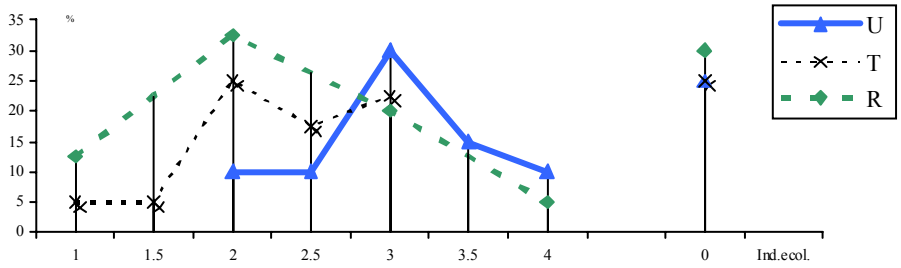

Fig. 3. The diagram of ecological indices of ass. *Vaccinio – Juniperetum communis* Kovács 1979

In terms of karyology, it is observed (Fig. 4) the predominance of polyploid species (P=47,5%) followed by diploid species (D = 25%), than diplo-polyploid species (DP=22,5%), for a total of 2 taxa not being able to determine the karytype (N = 5%). The diploids index is I = 0,47.

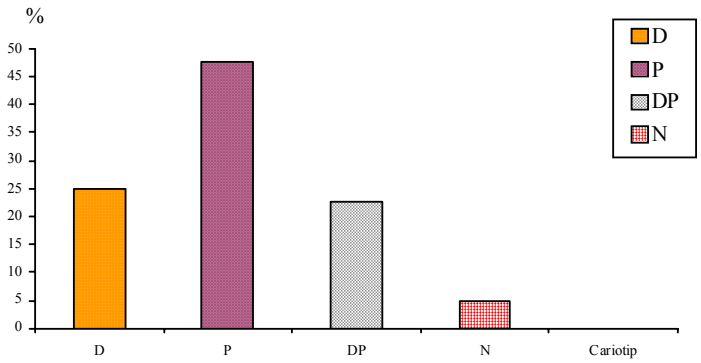

Fig. 4. The karytype spectrum of ass. *Vaccinio – Juniperetum communis* Kovács 1979

CONCLUSIONS

The phytocenoses of the association *Vaccinio – Juniperetum communis* Kovács 1979 from the northern part of Bihor Mountains are adapted to edaphic and microclimate conditions, with acidic and very acidic soils and low temperatures.

The association sums up a number of 43 taxa with high floristic diversity. We notice the presence of some protected species - vulnerable (*Arnica montana*), endemic (*Campanula serrata, Hieracium peterfii*) or rare (*Campanula patula ssp.abietina*).

The association *Vaccinio - Juniperetum communis* Kovács 1979 is included in the Romanian habitat R3108 southeastern Carpathian dwarf juniper (*Juniperus sibirica*), with corresponding in the Natura 2000 system to the habitat 4060 Alpine and boreal shrubs, included in the Habitats Directive Annex I, as requiring designation Special Areas of Conservation.

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REFERENCES

1. Bleahu M., 1981, *Monografia Munţii Bihor-Vlădeasa*, Edit. Sport-Turism, Bucureşti.
2. Borza A., 1934, *Studii fitosociologice în Munţii Retezat*, Bul. Grăd. Bot. şi al Muz. Botanic, Cluj, 16.
3. Borza A., Boşcaiu N., 1965, *Introducere în studiul covorului vegetal*, Edit. Academiei R.P.Române, Bucureşti, 340 p.
4. Boşcaiu N., Coldea Gh., Horeanu C., 1994, *Lista roşie a plantelor vasculare dispărute, periclitate, vulnerabile şi rare din flora României*, Ocrot. Nat. Med. Înconj., Bucureşti, 38,1, pp. 45-56
5. Braun-Blanquet J., 1928, *Pflanzensoziologie. Grundzüge der Vegetationskunde*, Biologische Studienbücher, 7, 1, Berlin, 330 p.
6. Braun-Blanquet J., Pavillard J., 1928, *Vocabulaire de sociologie végétale*, 3, Edit. Montpellier, 23 p.
7. Ciocârlan V., 2009, *Flora ilustrată a României*, Editura Ceres, Bucureşti, 1041 p.
8. Costică M., Ştefan N., Sârbu I., 2010, *Contribution to the study of the wood vegetation from the Suhard mountain*, Analele şt. Univ. „Al.I.Cuza", Iaşi, LVI, 1, II Biol.Veg., 65-81.
9. Cristea V., Gafta D., Pedrotti F., 2004, *Fitosociologie*, Editura Presa Universitară Clujeană, Cluj-Napoca.
10. Dihoru Gh., Negrean G., 2009, *Cartea Roşie a plantelor vasculare din România*, Edit. Academiei Române, 630 p.
11. Doniţă N., Popescu A., Paucă-Comănescu M., Mihăilescu S., Biriş I.A., *Habitatele din România*, Edit. Tehnică Silvică, Bucureşti, 2005.
12. Kovács Al., 1979, *Flora şi vegetaţia Munţilor Bodoc*, Aluta, Muz. Sf.Gheorghe, 11-13:363-405.

13. Pop Gr., 2006, *Carpaţii şi Subcarpaţii României*, Presa Universitară Clujeană, 260 p.
14. Resmeriţă I., 1982, *Vegetaţia clasei Vaccinio-Juniperetalia Pass. et Hoffm. 1968 din Carpaţii României*, Studii şi Comunic. Şt. Nat., 1979-1980, Bacău, 13:217-236.
15. Sanda V., Öllerer K., Burescu P., 2008, *Fitocenozele din România. Sintaxonomie, structură, dinamică şi evoluţie*, Universitatea din Bucureşti, Edit. Ars Docendi, 570 p
16. Tüxen R., Ellenberg H., 1937, *Der systematische und der ökologische Gruppenwert. Mitteilungen der floristischsoz. arbeitsgemeinschaft in niedersachsen*, 3:171-184