THE VEGETATION OF THE SPRUCE FOREST IN THE WESTERN CARPATHIANS, SOMEȘUL CLAD - SOMEȘUL RECE INTERSTREAM AREA. PHYTOCENOSES OF THE HIERACIOTRANSYLVANICI - PICEETUM ASSOCIATION.

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Abstract

Phytocenoses dominated by Piceaabies and Hieraciumtransylvanicum from the Western Carpathians grow in a cool humid climate, at altitudes ranging between 1103 m and 1535 m. They develop on predominantly northern and north-western-facing slopes of 6° - 28°, on acid brown earth soils, poor in nutrients, with humus of fine mull and moder type, of moderately to medium-deep, deeply skeletal, permanently moist and well drained soil. The floristic summary of the association Hieraciumtransylvanicum -Piceetum encloses 47 cormophytes and five bryophytes subordinated to the Soldanellomajorii-Piceetum alliance: Luyula sylvatica, Homogynealpina, Gymnocarpiumdryopteris, Calamagrostis villosa, orderPiceetaliaexcelsae: Dechamsiaflexuosa, Luzulaluzuloides, Dryopteris austriacaand the classVaccinio-Piceetea: Vaccinium myrtillus, Oxalis acetosella, Sorbus aucuparia, Campanula abietina, Lamiumgaleobdolon, Dryopteris cristata, Sphagnum girgenshonii. The layer of trees with a consistency ranging between 0.6 - 0.8 is populated by the dominating species, specific for the associationaforementioned i.e.Piceaabies, with coverage of 48.21%. As regards this associationbioforms, hemicryptophytes (51.06%) are dominant, followed by megaphanerophytes (14.89%) and chamaephytes(10.63%). In the spectrum of phytogeographic elements, we note the circumpolar species (31.91%) followed by the European ones (21.27%) and the Eurasian species (19.14%). Concerning the ecological factors i.e.moisture (M), temperature (T) and the chemical reaction of the soil (R), the mesophilsare dominant (63.82%) followed by the meso-hygrophila (21.27%) and eurihydrousspecies (8.51%), microtherms (46.80%) followed by micro-mesotherms (31.9%) and eurytherms (19.14%), acid-neutrophils (34.04%), and by acidophilic and euryionicspecies (25.53% each). The karyotype analysis reflects the share of polyploid species (53.09%), which adapted to the pedoclimatic conditions, followed by the diploid ones (40.42%), which forms the genetic reserve for species evolution.

Key words:phytocenoses, bioforms, floristic elements, ecological indices, karyotype.

INTRODUCTION

The montane forests populated with *Piceaabies* and *Hieraciumtransylvanicum* grow on skeletal, acid brown earthsoils, poor in

nutrients, with humus of fine mull and moder type, moderately to medium deep, permanently moist and well drained soils.

The relief consists of mountain with a gentle to strong slopes ranging 6° - 28°, and altitudes ranging from 1103 m - 1535 m. From the literature it results that there have been sporadic, non-exhaustive research works on the forest vegetation in the Western Carpathians, SomeşulCald-SomeşulRece interstream area. Paper works on the study of spruce forest are few and were carried out on small areas, not covering much of the territory subjected to our study, of which we recall: Pop et al., 1984; Pop and Hodişan, 1962;Togor, 2016;Burescu and Togor, 2010;, Burescu and Togor, 2012); Pop and Hodişan, 1981.

MATERIAL AND METHOD

The material of our research consists of the natural forest ecosystems dominated by the species *Piceaabies* and *Hieraciumtransylvanicum* from the Western Carpathians' SomeşulCald - SomeşulRece interstream area. We carried out 14 surveys, phytocenologicalrelevés for the most representative phytocenoses. In the Association table (see Table 1 below), we recorded all the species of plants we found with the assessment of abundance and dominance (AD) for each species according to the Braun-Blanquet and Pavillard scale, 1928. The population of boreal forests of *Piceaabies* with *Hieraciumtransylvanicum* was ecologically, phytocenologically and cytogenetically analyzed and characterized based on the association table and histograms with reference to the distribution of bioforms, floristic elements, ecological indices and genetic karyotypes.

Classification and description of the associations were made on the basis of the floristic criterion, with the help of characteristic, dominant anddifferential species. The name of the association is given in accordance with the provisions established by the International Code of Phytosociological Nomenclature developed by Weber et al., 2000.

Classification of species according to the corresponding cenotaxonomic units (sub-alliance, alliance, order, class) was carried out by observing the requirements of the eco-floristic systems developed by Tüxen, 1955;, Braun-Blanquet, 1964; and based on the information provided in the most recent papers of Coldea et al., 1997 and Sanda et al., 2008.

The ecological and phytocenological characterization of the species within the surveyed area was done according to Sanda et al. (2003), Ciocârlan, 2009, and Sârbu et al., 2013.

The information on the level of ecological indices, bioforms, floristic elements, number of chromosomes are presented according to the synthesis

works developed by Ellenberg, 1979; Pop, 1977, 1982; Sanda et al., 1983, 2003, 2008; Cristea et al., 2004;Ciocârlan, 2009;Burescu and Toma, 2005; and Doniţă et al., 2005.

We analysed the phytocenoses in terms of categories of ecoforms, moisture (M), temperature (T) and chemical reaction of the soil (R) according to the works of Sanda et al., 1983, 2003, who adapted the ecological index values for the plants in Central Europe classified on a scale ranging from 1 to 9 according to Ellenberg, 1979, to the specific pedoclimatic conditions of Romania using, this time, a scale ranging between 1 and 6. Classification of species in the corresponding cenotaxa was carried out according to the works of Borza et Boşcaiu, 1968. Cytogenetic analysis of the species by karyotype was done according to the works of Sanda et al., 2003.

RESULTS AND DISCUSSION

Spruce stands dominated by *Piceaabies* and *Hieraciumtransylvanicum* are well represented in the SomeşulRece river basin.

The floristic inventory of the spruce stands aforementioned gathers 52 species (see Table 1), which means a high biodiversity. A number of 23 species belong to the basic cenotaxa of the association, of which eight species belong to *Soldanellomajori-Piceion, Piceionexcelsae (Luyula sylvatica, Homogynealpina, Gymnocarpiumdryopteris, Calamagrostis villosa, Gentianaasclepiadea, Vaccinium vitis-idaea, Melampyrumsylvaticum, Dryopteisdilatata)*, three speciesto *Piceetalia (Dechamsiaflexuosa, Luzulaluzuloides, Dryopteris austriaca)*, 12 species to*Vaccinio- Piceetea (Vaccinium myrtillus, Oxalis acetosella, Sorbus aucuparia, Campanula abietina, Lamiumgaleobdolon, Dryopteris cristata, Sphagnum girgenshonii, Dicranumscoparium, Hypericum maculatum, Lonicera nigra, Daphne mezereum, Lycopodium annotinum)*.

The tree layer has a consistency ranging between 0.6 and 0.8 with diameters between 20 cm and 48 cm and heights from 20 m to 30 m. The herbaceous layer has an overall coverage of 47.85%. The moss layer has an overall coverage of 48.21%.

Table 1

*Hieraciotransylvanici- Piceeteum*Pawlowski et Br. Bl. 1939

Biof.	Floristic elements	M	T	R	K	Survey no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	K	ADm
						Altitude (m)	1291	1194	1517	1496	1497	1535	1242	1522	1103	1178	1176	1299	1388	1167		
						Exposition	SV	N	N	N	N	E	SE	N	NV	NV	NV	N	V	NV		
						Slope (º)	18	28	16	12	10	8	22	6	9	20	10	14	12	26		
						Tree layer consistency	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.7	0.8		
						Tree height (m)	24-26	22-24	26-28	28-30	26-28	24-26	26-28	26-28	20-22	20-22	28	24-26	20-22	22-24		
						Tree diameter (cm)	36-40	26-28	36-38	38-40	34-36	36-38	34-36	36-38	22-24	20-22	46-48	38-40	26-28	24-26		
						Shrub layer coverage (%)	-	-	-	-	-	-	-	-	-	2	2	-	-	2		
						Herbaceous layer coverage (%)	80	20	60	70	60	50	60	70	30	40	40	30	40	20		
						Moss layer coverage (%)	20	60	30	30	40	50	40	30	60	60	60	50	30	15		
						Surface (sq.m.)	400	800	800	400	800	800	800	800	800	800	800	800	800	800		
H	Carp-B	3	0	0	D	*As.Hieraciumtransylvanicum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	0.5
MPh	E	0	0	0	D	*As. Piceaabies*	3	4	4	3	4	3	4	3	4	4	4	3	4	4	V	48.21
						Soldanellomajori-Picenion. Piceionexcelsae																
H	EC	3.5	2.5	2	DP	*Luzula sylvatica*	1	2	+	+	+	.	.	+	+	1	+	+	+	1	V	2.6
H	Alp-E	3.5	2.5	2.5	P	*Homogynealpina*	+	.	+	1	+	+	.	1	.	+	+	1	+	.	IV	1.32
G	Cp	3	2.5	2	P	*Gymnocarpiumdryopteris*	+	+	.	.	.	.	.	+	+	+	+	+	+	+	IV	0.32
H	Eua	4	2.5	1.5	P	*Calamagrostis villosa*	+	1	1	1	2	.	+	+	1	+	.	.	.	+	IV	2.85
H	EC	4	2	4	P	*Gentianaasclepiadea*	.	.	.	.	.	.	.	.	.	+	.	+	.	+	II	0.1
Ch	Cp	3	2	1	D	*Vaccinium vitis-idaea*	.	.	.	.	.	.	+	.	+	+	.	.	.	+	II	0.14
Th	E	3	0	1.5	D	*Melampyrumsylvaticum*	.	.	.	.	.	.	.	.	.	+	+	.	.	.	I	0.07
H	Cp	3.5	0	0	P	*Dryopteris dilatata*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	0.03
						Piceetaliaexcelsae																
H	Cp	0	0	1	P	*Deschampsiaflexuosa*	1	+	2	2	+	3	1	1	+	1	2	1	+	.	V	8.35
H	E	2.5	2.5	2	DP	*Luzulaluzuloides*	.	.	.	.	.	.	+	.	+	.	.	+	+	.	II	0.14
H	Cp	3.5	0	0	P	*Dryopteris austriaca*	.	.	.	.	.	.	.	.	+	+	+	.	+	+	II	0.17
						Vaccinio-Piceetea																
Ch-nPh	Cp	0	2	1	D	*Vaccinium myrtillus*	+	+	+	+	.	1	+	1	1	+	1	1	+	+	V	2.07
H-G	Cp	4	3	3	D	*Oxalis acetosella*	+	3	+	+	+	+	+	1	+	+	1	1	3	1	V	7.07
MPh-ml	E	3	2.5	2	D	*Sorbus aucuparia*	+	.	+	1	+	.	+	.	+	+	+	+	+	+	IV	0.35
H	End	3.5	2	2	P	*Campanula abietina*	.	.	.	.	.	+	+	.	+	+	.	+	+	+	III	0.25
H	Ec	3	0	4	D	*Lamiumgaleobdolon*	.	+	.	.	.	.	.	+	+	+	+	+	+	+	III	0.28
H	Cp	3.5	2	3	P	*Dryopteris cristata*	.	1	+	+	+	+	+	+	.	.	.	+	.	.	III	0.6
						Sphagnum girgenshonii	.	.	2	1	1	.	+	.	1	+	.	+	.	.	III	2.42
						Dicranumscoparium	1	2	.	.	.	1	.	.	.	+	1	.	.	.	II	2.35
H	Eua	4	3	2	D	*Hypericum maculatum*	.	.	.	.	.	.	.	.	.	+	.	.	+	+	II	0.1
mPh	EC	3	2	3	D	*Lonicera nigra*	.	.	.	.	.	.	.	.	.	+	+	.	.	+	II	0.1

Biof.	Floristic elements	M	T	R	K	Survey no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	K	ADm
nPh	Eua	3.5	3	3	D	*Daphne mezereum*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	0.03
Ch	Cp	4	2.5	2	P	*Lycopodium annotinum*	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	0.03
						Querco-Fagetea																
nPh	E	3	2.5	3	P	*Rubushirtus*	+	.	.	.	.	.	.	.	.	+	+	+	+	+	III	0.21
H	Cosm	4	2.5	0	P	*Athyrium filix-femina*	.	+	.	.	.	+	.	.	.	.	+	+	+	+	III	0.21
MPh	E	3	3	0	D	*Fagus sylvatica*	+	+	.	.	.	.	.	.	.	.	.	.	.	+	II	0.1
Ch	Eua	2	2	2	DP	*Veronica officinalis*	.	.	.	.	.	+	+	.	.	.	+	.	+	.	II	1.14
MPh	Ec	4	3	0	D	*Abies alba*	.	.	.	.	.	.	.	.	.	.	+	+	+	+	II	1.14
MPh	Ec	3.5	3	3	P	*Acer pseudoplatanus*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	0.03
MPh	Eua	3	2	2	P	*Betula pendula*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I	0.03
H	E	3	3	3	D	*Mycelismuralis*	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	0.03
H	E	3.5	3.5	3.5	P	*Polystichumaculeatum*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I	0.03
H	Cp	3.5	3	3	D	*Milliumeffusum*	.	.	.	.	.	.	.	.	.	.	+	.	.	+	I	0.07
mPh	B	3	3	3	D	*Corylus avellana*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I	0.03
Th	E	3	3	0	P	*Galeopsistetrahit*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I	0.03
Th	E	3	2	0	D	*Galeopsisspeciosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	0.03
						Epilobieteaangustifolii																
nPh	Cp	3	3	3	DP	*Rubusidaeus*	.	+	.	.	.	+	.	.	.	.	.	.	.	+	II	0.1
H	Cp	2.5	2	3	D	*Solidagovirgaurea*	.	.	.	.	.	.	.	.	.	+	+	+	+	+	II	0.17
H	Eua	3.5	3	3	P	*Senecio nemorensis*	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	0.07
H	Cp	3	3	3	P	*Gnaphalium sylvaticum*	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	0.07
						Variaesyntaxa																
						Polytrichum strictum	1	2	+	1	2	2	1	1	1	+	+	1	1	1	V	4.14
						Ritidiadelfustriqueter	1	1	1	.	.	1	.	1	2	2	1	2	2	.	IV	7.14
						Polytrichum commune	.	.	1	1	1	1	3	2	.	+	1	+	+	1	IV	6.17
H	Cp	4	1.5	0	P	*Epilobiumalpinum*	+	+	.	.	.	+	+	.	.	.	.	.	+	.	II	0.17
G	E	3	2.5	2.5	P	*Polygonatumvetricilatum*	.	.	+	.	.	.	.	+	.	+	+	.	.	+	II	0.17
mPh	Alp-Carp-B	4	2	2	D	*Salix silesiaca*	.	.	.	.	.	+	.	.	.	.	.	.	.	+	I	0.07
H	Eua	0	0	0	P	*Potentilla erecta*	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I	0.03
Ch	Cosm	3	0	0	P	*Cerastiumholeosteoides*	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	0.03
H	Cp	4	2.5	3	P	*Carexleporina*	.	+	.	.	.	+	.	.	.	.	.	.	.	.	I	0.07
MPh	Eua	3	3	3	P	*Sambucus nigra*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I	0.03

Place and date of surveys: 1. Făget, 10.08.2018; 2. Lina, 14.09.2018; 3-5. Steaua, 28.07.2019; 6. VârfulLămășoaia, 10.08.2019; 7. ValeaCracilor 11.08.2019; 8. Negru, 11.08.2019; 9. Ghiduri, 11.09.2018; 10-13. Fântânele - CruceaIancului, 11.09.2019; 14. ValeaCălinesei, 12.09.2019.

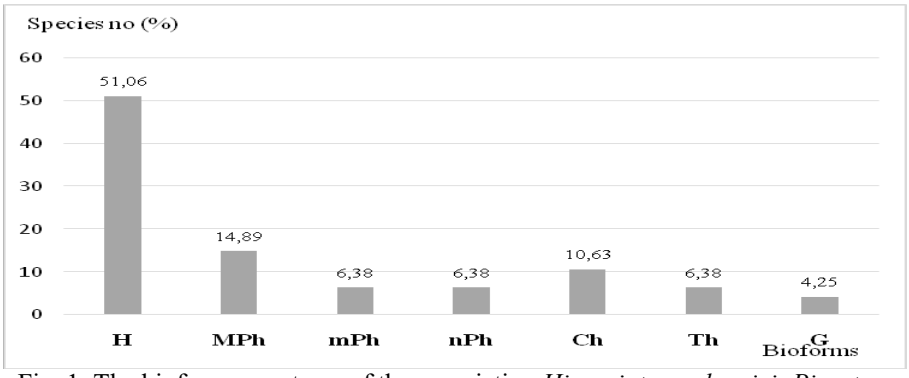

Fig. 1. The bioforms spectrum of the association *Hieraciotransylvanici- Piceetum*
Caption: H = Hemicryptophytes; MPh = Megaphanerophytes; Ch = Chamaephytes; mPh = Mesophanerophytes; nPh = Nanophanerophytes; Th = Therophytes; G = Geophytes.

The bioforms of the association *Hieraciotransylvanici-Piceetum* (see Fig 1 above), are dominated by the hemicryptophytes (51.06%), megaphanerophytes (14.89%) mesophanerophytes (6.38%), nanophanerophytes (6.38%), chamaephytes (10.63%), therophytes (6.38%), and last by geophytes (4.25%).

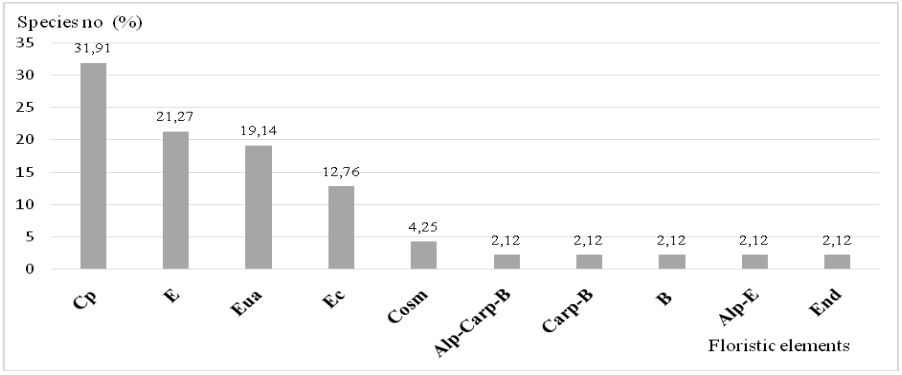

Fig. 2. The floristic elements spectrum of the association *Hieraciotransylvanici-Piceetum*
Caption: Cp = Circumpolar; E = European; Eua = Eurasian; Ec = Central European; Cosm = Cosmopolitan; Alp-Carp-B = Alpine-Carpathian-Balkan; Carp-B = Carpathian-Balkan; B = Balkan; Alp-E = Alpine-European; End = Endemite species

In terms of geographical area and current distribution of the species (see Fig. 2), the phytocenoses of the association *Hieraciotransylvanici - Piceetum* are dominated by the circumpolar (31.91%), European (21.27%), Eurasian (19.14%), Central European (12.76%), cosmopolitan (4.25%) species, followed by Alpine-Carpathian-Balkan, Carpathian-Balkan, Balkan, Alpine-European and endemic species with the lowest percentage (i.e. 2.12% each).

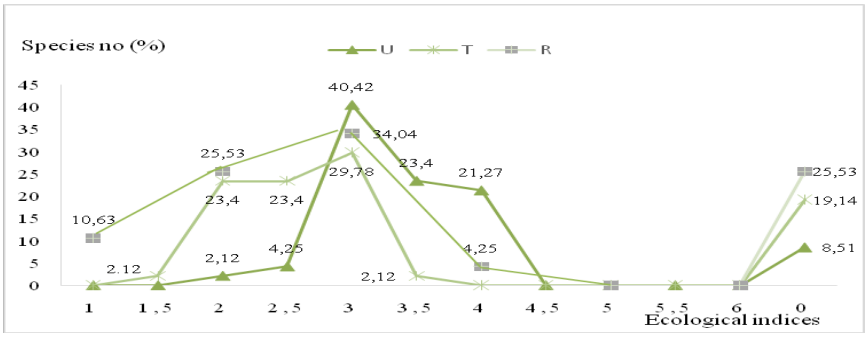

Fig. 3. Diagram of ecological indices of the association *Hieraciotransylvanici–Piceetum*

The analysis of ecoforms (see Fig 3 above) shows that mesophiles (63.82%) are dominant in terms of soil moisture, followed by meso-hygrophila(21.27%), eurihydrous (8.51%), and by xero-mesophiles (6.37%). By temperature, microtherms (46.80%) are dominant, followed by micro-mesotherms (31.9%), eurytherms (19.14%) and by cryophiles (2.12%). In terms of the chemical reaction of the soil, the acidic-neutrophilic species (34.04%) are dominant, followed by the acidophilic and euryionicspecies with the same percentage (25.53%), highly acidophilic species (10.63%), andlast by acidic-neutrophilic species (4.25%).

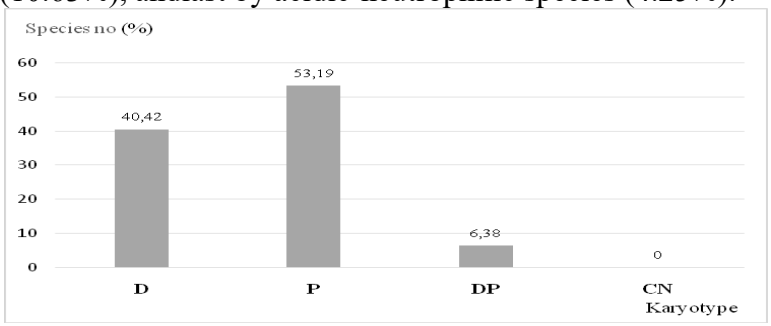

Fig. 4. The karyological spectrum of the association *Hieraciotransylvanici- Piceetum*
Caption: D = Diploid, P = Polyploid, DP = Diplo-Polyploid, UK = Unknown karyotype

From the karyological point of view (See Chart no 4 above), within the *Hieraciotransylvanici-Piceetum* association, polyploid species are dominant (53.19%) since they have adapted to the harsh pedoclimatic environment, followed by the diploids (40.42%) which form the genetic reserve for evolution, and diplo-polyploid species (6.38%).

Phytocenoses dominated by *Piceaabies*with *Hieraciumtransylvanicum* and *Luzula sylvatica*are high conservation value areas (Doniță et al., 2005), sheltering endemic species (*Campanula abietina*), species of very high economic importance in the wood conversion industry (*Piceaabies, Abies alba*), food industry (*Vaccinium myrtillus, Vaccinium vitis-idaea,Corylus avellna*), pharmaceutical industry (*Veronica*

officinalis), ornamental (*Betula pendula, Lonicera nigra*) and honey plant species (*Rubusidaeus, Rubushirtus*).

Priority natural habitat of community interest: NATURA 2000: 9410 the *Picea* acidophilic forests from the mountain to alpine floor (*Vaccinio-Piceetea*), R4208 Southeast Carpathian spruce forests (*Piceaabies*) and fir (*Abies alba*) forests with *Luzulasyilvatica*(Doniță, 2005).

Regarding the floristic composition, following the analysis of the Association table (see Table 1 below) and of histograms, and in comparison with the work of Togor, 2016, one may notice that we found in this association a number of 52 species while Togor, 2016, found 68 species, of which within the alliance and sub-alliance we found eight species while Togor, 2016, found nine species; in our research the order encloses three species while in the case of Togor's work (2016) the order includes four species; our study reveals that the class contains a total number of 12 species and in Togor's research (2016) the class has 18 species.

Comparing the bioforms spectrum, it appears that the hemicryptophytes are dominant with a share of 51.06% and in Togor's study, 2016 with 50%, respectively; the phytogeographic elements are represented by the circumpolar species with 31.91% share while in Togor's case, 2016 with 24.24% share; the ecological index chart shows that mesophilesare dominant with 63.82% percentage and in Togor's study (2016) with a 60.61% percentage; microtherms have a 46.8% share and in Togor's study, 2016, only 45.45%; acid-neutrophils are dominant in our study (34.04%) while in Togor's study (2016) the acidophils are dominant (29.76%). From the cariologic analysis it results that polypoidsreach in our study the highest percentage i.e. 53.19%, almost similar with the one reached in Togor's study (2016) i.e. 54.54%.

From the analysis aforementionedit results that the outputsof the two studies are close because the surveyedareas are adjacent and have the same pedoclimatic conditions.

CONCLUSIONS

1. Phytocenoses of the *Hieraciotransylvanicui - Piceetum* association are dominated by hemicryptophytes (51.06%), followed by megaphanerophytes (14.89%) and chamaephytes (10.63%), which are all adapted to the temperate-continental climate of the Western Carpathians geographical area.
2. Circumpolar (31.91%) and Eurasian (19.14%) species predominate in the geographical area of the association *Hieraciotransylvanici-Piceetum*.
3. Ecological indices show that, in terms of soil moisture, mesophiles are dominant (63.82%), concerning the temperature microtherms

dominate(46.8%), and as far as the chemical reaction of the soil is concerned acid-neutrophils are dominant (34.04%).

4. By karyotype, in the genetic structure of the phytocenoses of the association *Hieraciotransylvanici - Piceetum*, the polyploid species (53.19%) are dominant, followed by the diploids (40.42%) which form the genetic reserve for the evolution of species.

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