

SPRUCE FORESTS FROM THE CEHLĂU MOUNTAIN

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The aim of our research is to describe the characteristics of the spruce forests from the Ceahlău Mountain. The research area was the central part of the northern Oriental Carpathians, where the spruce forests form a continuous belt between the altitudes of 1010 m and 1820 m, the upper limit being just below the sub-alpine plateau. Based on a significant number of relevés, the spruce communities were classified in three associations belonging to the class *Vaccinio-Piceetea*, order *Picetalia excelsae*, alliance *Piceion excelsae*, which are *Soldanello montanae-Piceetum*, *Heracio transsilvanio-Piceetum*, *Leucanthemo waldsteinii-Piceetum*. For each association we present the location, the phytosociological and ecological characterisation and the phytosociological table of relevés.

Key words: spruce forests, phytosociological analysis, Ceahlău Mountain, national park.

INTRODUCTION

The Ceahlău Mountain, whose central part was designated a national park, is located in the centre of the northern part of the Oriental Carpathians, in the western extremity of Neamţ County. The boundaries of the mountain are Bistricioara River towards north, Izvoru Muntelui-Bicaz reservoir towards east, Bicaz River towards south, and the streams Pântec and Bistra towards south-west.

The mountain is made of sedimentary rocks (Mesozoic and partially Mesozoic). The rocks are from parallel layers with a north-to-south orientation, and with a fall towards east.

According to the pedo-geographical zonation [2], the Ceahlău region belongs to the zone with acid, mountain brown forest soils. In spruce forests, the soil shows a shallow layer of raw, peaty, humus.

The air temperature varies a lot in the Ceahlău Mountain. Thus, the temperature differences between the unshaded and shaded slopes of 2 to 5 °C are also expressed by the vegetation structure. The rainfall is relatively low varying between 544 mm in Bicazu Ardelean and 988 mm in Durău [11].

MATERIAL AND METHODS

We used the classical method for vegetation research by J. Braun-Blanquet, completed and adapted to the local conditions. In order to describe the forest communities, we carried out an extensive investigation.

The relevés were sampled under various conditions in regard to the altitude, exposition, slope, and periods of the vegetation season, with the aim to achieve the complete picture of the grass layer composition. Consequently, the relevés were analysed for the identification of the associations to which they belong.

RESULTS AND DISCUSSION

1. Association *Soldanello montane-Piceetum* VolK. in Br.-Bl. et al., 1939

The plant communities with *Picea abies* and *Soldanella montana* are largely extended in the area with moderate to steep slopes and highly acid soils [8, 9].

The tree layer is dominated by *Picea abies*, followed by *Acer pseudoplatanus*, *Sambucus racemosa*. The shrub layer is dominated by *Rubus idaeus*, *Daphne mezereum*. The dominant species of the grass layer are *Calamagrostis villosa*, *Dryopteris dilatata*, *Luzula sylvatica*, *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, and *Luzula luzuloides* (Table 1).

2. Association *Hieracio transilvanico-Piceetum* Pawl. et Br.-Bl., 1939

The spruce forests of this association are largely spread on the slopes of the upper mountain level of the Romanian Carpathians [5, 7], and form the spruce sub-zone of the forest zone [3].

These forests grow on soils which are acid or moderately acid, brown, and poor in moder humus [1].

In the tree layer, which covers 65–90%, the dominant species is *Picea abies*. Because of the soil acidity, most of grass layer includes mostly acidophilous species and covers less than 25% of the investigated area.

A remarkable aspect is the presence of many characteristic species for the order and the alliance [10].

Towards the lower boundary of the spruce forest, beech forest species appear in the floristic composition of the investigated communities. In addition, there are many saxicolous species that grow on calcareous or siliceous rocks (class *Asplenieta trichomanis*) and on scree and blocks resulted from erosion of the rocks (class *Thlaspietea rotundifolii*), plus the hygrophilous and nitrophilous weeds (class *Mulgedio-Aconietea*) 5 (Table 2).

3. Association *Leucanthemo waldsteinii-Piceetum* Krajina 1933

The plant communities of this association are less spread in the Oriental and Occidental Carpathians [4]. Mostly, they occur on river banks and in mountain depressions, on soils which are acid, brown, umbric, mesotrophic, rich in humus, and with a pH between 5.5 and 6.2 [6].

Because these phytocoenoses live in hygrophilous and nitrophilous habitats, they include many weed species of the classes *Mulgedio-Aconietea* and *Galio-Urticetea*. Additionally, for the reason that they live at relatively low altitudes, in contact with the beech forests, the spruce forests are invaded by deciduous forest plants [7] and the grass layer is dominated by species of the *Molinio-Arrhenatheretea* class (Table 3).

Table 1

Ass. *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939

Relevé number	1	2	3	4	5	6	7	8	9	10	
Altitude (m)	1680	1780	1810	1670	1750	1550	1870	1750	1650	1600	
Exposition	V	V	V	NV	N	N	NE	E	E	S	
Slope (degrees)	15	30	20	40	40	30	30	10	25	35	
Tree layer cover (%)	90	90	90	65	65	80	80	90	65	90	K
Shrubs + juveniles cover (%)	5	5	5	5	5	5	5	5	5	5	
Grass layer cover (%)	15	10	5	5	10	5	5	5	15	5	
Ass. Charact. Sp.											
<i>Soldanella montana</i>	+	-	+	+	+	+	+	+	-	+	IV
<i>Hieracium transsilvanicum</i>	+	+	+	+	+	-	-	-	-	+	III
<i>Leucanthemum waldsteinii</i>	-	-	-	-	-	-	+	-	-	+	I
<i>Piceion excelsae</i>											
<i>Luzula sylvatica</i>	+	+	+	+	1	-	+	-	1	-	IV
<i>Dryopteris dilatata</i>	+	+	+	+	+	-	-	+	-	-	III
<i>Athyrium distentifolium</i>	-	-	-	-	-	+	-	-	-	-	I
<i>Calamagrostis villosa</i>	+	+	-	+	-	+	+	-	+	-	III
<i>Piceetalia excelsae</i>											
<i>Ranunculus carpaticus</i>	+	+	-	-	-	-	+	+	+	-	III
<i>Luzula luzuloides</i>	-	-	+	-	+	-	-	-	-	-	I
<i>Calamagrostis arundinacea</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Picea abies</i>	5	5	5	4	4	5	5	5	4	5	V
<i>Athyrio - Piceetalia</i>											
<i>Daphne mezereum</i>	+	-	-	-	-	-	-	-	+	-	I
<i>Vaccinio - Piceetea</i>											
<i>Sorbus aucuparia</i>	+	-	-	-	-	+	-	-	+	-	II
<i>Lonicera nigra</i>	+	+	-	+	+	-	-	+	-	-	III
<i>Campanula abietina</i>	+	+	+	-	-	-	+	+	+	+	IV
<i>Luzula pilosa</i>	+	+	-	-	-	+	-	-	1	-	II
<i>Oxalis acetosella</i>	1	1	+	+	+	+	+	+	+	+	V
<i>Homogyne alpina</i>	-	+	-	+	+	+	+	-	-	-	III
<i>Vaccinium myrtillus</i>	-	-	+	+	+	+	-	-	+	-	III
<i>Vaccinium vitis-idaea</i>	-	-	-	+	-	-	-	+	-	+	II
<i>Gymnocarpium dryopteris</i>	-	-	-	-	+	-	-	-	-	-	I

Relevé number	1	2	3	4	5	6	7	8	9	10	
<i>Moneses uniflora</i>	-	-	-	-	+	-	+	+	-	-	II
<i>Goodyera repens</i>	-	-	-	-	-	-	+	+	-	-	I
<i>Lycopodium selago</i>	-	-	-	-	-	-	+	-	-	-	I
<i>Quercus - Fagetea</i>											
<i>Acer pseudoplatanus</i>	+	-	-	-	-	-	+	-	-	-	I
<i>Dentaria glandulosa</i>	+	+	+	-	-	-	+	+	+	+	IV
<i>Veronica urticifolia</i>	+	+	-	-	-	-	-	-	+	-	II
<i>Mycelis muralis</i>	+	+	-	-	-	-	-	-	+	-	II
<i>Myosotis sylvatica</i>	+	+	+	-	-	-	+	+	+	-	III
<i>Lamium galeobdolon</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Dryopteris filix-mas</i>	+	+	+	-	-	-	-	-	-	-	II
<i>Symphytum cordatum</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Moehringia trinervia</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Veronica montana</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Primula elatior ssp. leucophylla</i>	-	-	-	-	-	-	+	+	-	-	I
<i>Adoxa moschatellina</i>	-	-	-	-	-	-	+	-	+	-	I
<i>Galium schultesii</i>	-	+	-	-	+	-	-	-	+	-	II
<i>Asplenieta et Thlaspieta</i>											
<i>Asplenium ramosum</i>	-	-	+	-	-	-	-	-	-	-	I
<i>Polypodium vulgare</i>	-	-	-	-	+	-	-	-	-	-	I
<i>Asplenium ruta-muraria</i>	-	-	-	-	+	-	-	-	-	-	I
<i>Campanula carpatica</i>	-	-	-	-	+	-	-	-	-	-	I
Variae syntaxa											
<i>Veronica chamaedrys</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Fragaria vesca</i>	+	-	-	-	-	-	-	-	-	-	I

Relevés site and date: 1–2 La Scaune 08.08.68; 3 Jgheabul lui Vodă 08.08.68; 4 Jgheabul Piciorul Șchiop 09.08.68; 5 Jgheabul Rupturii stream 09.08.68; 6 “La Morminte” 09.08.68; 7 base of Toaca 12.08.68; 8 base of Ocolașul Mare 13.08.68; 9 “La Grohot” 31.08.69; 10 base of Detunata 31.08.69

Table 2

Ass. *Hieracio transsilvanico-Piceetum* Pawl. et Br.-Bl., 1939

Relevé number	1	2	3	4	5	6	7	8	9	10	K
Altitude (m)	1550	1355	1230	1120	1250	1225	1360	1010	1220	1300	
Exposition	S	NV	SE	S	V	NV	NV	NV	E	E	
Slope (degrees)	35	35	15	15	35	40	45	30	5	15	
Tree layer cover (%)	80	80	85	90	80	65	70	90	90	70	
Shrubs + juveniles cover (%)	5	5	5	5	5	5	5	5	5	5	
Grass layer cover (%)	5	35	25	20	5	5	5	5	20	15	

Relevé number	1	2	3	4	5	6	7	8	9	10	K
<i>Soldanella montana</i>	-	-	-	-	-	-	-	-	+	-	I
<i>Hieracium transsilvanicum</i>	+	+	+	+	+	-	-	+	+	+	V
<i>Leucanthemum waldsteini</i>	-	+	-	-	-	-	-	-	-	-	I
				<i>Piceion excelsae</i>							
<i>Luzula sylvatica</i>	+	-	-	+	+	-	-	-	-	-	II
<i>Dryopteris dilatata</i>	-	+	-	+	-	+	+	+	-	-	III
<i>Athyrium distentifolium</i>	+	-	-	-	-	-	-	-	+	-	I
<i>Calamagrostis villosa</i>	+	-	-	-	-	-	+	-	-	-	I
<i>Phegopteris conecitlis</i>	-	-	-	-	+	-	-	+	-	-	I
<i>Coralorrhiza trifida</i>	-	-	-	-	-	-	-	+	-	+	II
				<i>Dicrano – Pinion</i>							
<i>Veronica officinalis</i>	+	-	-	-	+	+	+	-	-	-	II
<i>Monotropa hypopitys</i>	-	-	-	-	-	-	+	+	-	-	I
<i>Dicranum scoparium</i>	-	-	+	-	+	-	+	-	+	-	II
				<i>Piceetalia excelsae</i>							
<i>Ranunculus carpaticus</i>	+	-	+	-	+	-	-	+	-	+	III
<i>Luzula luzuloides</i>	+	+	+	+	-	+	+	+	+	-	IV
<i>Calamagrostis arundinacea</i>	+	2	-	-	+	-	-	-	-	+	II
<i>Picea abies</i>	5	5	5	5	5	4	4	5	5	4	V
				<i>Abieti – Piceion</i>							
<i>Abies alba</i>	+	+	+	+	+	+	-	+	-	-	III
				<i>Chrysanthemo – Piceion</i>							
<i>Veratrum album</i> var. <i>lobelianum</i>	-	-	-	-	-	-	-	-	+	-	I
				<i>Athyrio – Piceetalia</i>							

Relevé number	1	2	3	4	5	6	7	8	9	10	K
<i>Daphne mezereum</i>	-	-	-	-	-	-	-	+	+	+	II
<i>Polystichum lonchitis</i>	-	-	-	+	+	+	+	+	-	-	II
<i>Athyrium filix-femina</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Valeriana tripteris</i>	+	-	-	+	-	+	-	-	-	-	II
<i>Rosa pendulina</i>	-	-	-	-	-	-	-	+	-	-	I
<i>Mercurialis perennis</i>	-	-	-	+	+	-	-	+	-	-	I
				Vaccinio – Piceetea							
<i>Sorbus aucuparia</i>	+	+	+	-	-	+	+	-	+	-	III
<i>Lonicera nigra</i>	-	-	-	+	+	-	-	+	-	-	II
<i>Campanula abietina</i>	+	+	+	-	-	+	+	-	-	+	IV
<i>Luzula pilosa</i>	-	-	-	-	-	+	+	+	+	-	II
<i>Oxalis acetosella</i>	+	+	2	2	+	+	+	+	2	1	V
<i>Homogyne alpina</i>	+	-	-	+	+	-	-	+	-	-	II
<i>Vaccinium myrtillus</i>	-	-	-	+	-	+	-	+	-	-	II
<i>Vaccinium vitis-idaea</i>	-	-	-	-	-	-	-	-	+	-	I
<i>Gymnocarpium dryopteris</i>	-	-	-	-	+	+	-	+	-	-	II
<i>Moneses uniflora</i>	-	-	+	-	-	-	+	-	-	-	II
<i>Goodyera repens</i>	-	-	-	+	+	-	-	-	+	-	I
<i>Lycopodium selago</i>	-	+	+	-	-	+	-	-	-	-	II
<i>Orhithia secunda</i>	-	-	+	-	-	-	-	+	+	-	I
<i>Circaea alpina</i>	+	+	+	-	+	-	+	-	-	-	III
				Quercu – Fagetea							
<i>Acer pseudoplatanus</i>	+	+	+	+	-	+	-	-	-	-	III
<i>Dentaria glandulosa</i>	-	-	+	+	+	+	+	-	+	+	IV

Relevé number	1	2	3	4	5	6	7	8	9	10	K
<i>Veronica urticifolia</i>	-	+	+	-	+	+	-	-	-	-	II
<i>Mycelis muralis</i>	+	+	+	+	+	-	+	+	-	-	IV
<i>Myosotis sylvatica</i>	+	+	+	-	-	+	-	-	+	+	III
<i>Lamium galeobdolon</i>	-	-	-	-	+	-	+	+	+	+	III
<i>Dryopteris filix-mas</i>	+	+	+	+	-	-	+	-	-	-	III
<i>Symphytum cordatum</i>	-	-	+	-	-	-	-	+	+	+	II
<i>Moehringia trinervia</i>	+	-	-	-	-	-	-	-	+	+	II
<i>Veronica montana</i>	-	-	-	-	-	-	-	-	+	-	I
<i>Primula elatior</i> ssp.	-	-	-	-	-	-	+	-	-	-	I
<i>Leucophylla adoxa</i>	-	-	-	+	-	-	-	-	-	-	I
<i>moschatellina</i>	-	-	-	-	-	-	-	-	-	-	I
<i>Cardamine impatiens</i>	+	-	-	-	-	-	-	-	+	+	II
<i>Salvia glutinosa</i>	+	+	+	+	-	-	-	+	+	+	IV
<i>Euphorbia amygdaloides</i>	+	-	-	+	-	-	+	-	-	-	II
<i>Polystichum aculeatum</i>	-	-	+	-	-	-	-	-	+	-	I
<i>Pulmonaria rubra</i>	-	+	-	-	+	-	-	-	+	-	II
<i>Galium schultesii</i>	-	+	-	-	+	-	-	-	+	-	II
<i>Fagus sylvatica</i>	-	-	+	-	-	-	+	-	-	+	II
<i>Carex digitata</i>	-	-	-	+	-	-	-	+	-	-	I
<i>Hepatica transsilvanica</i>	-	-	-	-	-	+	+	-	+	-	II
<i>Anemone nemorosa</i>	-	-	+	+	-	-	-	-	-	-	I
<i>Acer platanoides</i>	-	-	-	+	-	-	+	-	-	-	I

Relevé number	1	2	3	4	5	6	7	8	9	10	K
<i>Aconitum moldavicum</i>	-	-	-	-	+	-	-	-	-	-	I
<i>Poa nemoralis</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Galeopsis speciosa</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Galium odoratum</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Epilobium montanum</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Asplenietea et Thlaspietea</i>											
<i>Asplenium ramosum</i>	-	-	+	+	+	+	-	-	-	-	II
<i>Polypodium vulgare</i>	-	+	-	+	+	+	-	-	-	-	II
<i>Asplenium ruta-muraria</i>	-	-	-	-	-	-	-	-	+	+	I
<i>Campanula carpatica</i>	-	-	-	+	-	-	-	-	-	-	I
<i>Spiraea chamaedryfolia</i>	-	-	-	-	+	+	-	-	-	-	I
<i>Asplenium trichomanes</i>	-	-	+	-	-	-	-	-	-	-	I
<i>Campanula rotundifolia</i>	+	-	-	-	-	-	-	-	-	-	I
<i>ssp. kladniana</i>	-	-	-	-	-	-	-	-	-	-	I
<i>Epilobium collinum</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Mulgedio-Aconietea</i>											
<i>Gentiana asclepiadea</i>	-	+	+	+	+	+	-	-	-	+	III
<i>Corchusa mathioli</i>	-	-	-	-	+	-	-	-	+	-	I
<i>Doronicum carpaticum</i>	-	-	-	-	-	-	-	-	-	+	I
<i>Ribes alpinum</i>	-	-	+	-	-	-	-	-	+	-	I
<i>Polygonatum verticillatum</i>	-	-	+	-	-	-	-	-	-	+	I
<i>Stachys sylvatica</i>	-	-	-	-	-	-	+	-	-	-	I
<i>Crepis paludosa</i>	-	-	-	-	-	-	-	-	+	-	I

	1	2	3	4	5	6	7	8	9	10	K	
<i>Stellaria nemorum</i>	-	+	-	-	-	-	-	-	-	-	-	I
<i>Geranium robertianum</i>	-	-	-	+	+	+	-	-	-	+	+	I
<i>Urtica dioica</i>	-	-	-	-	-	-	-	-	-	-	-	I
<i>Rumex acetosa</i>	+	+	-	-	-	-	-	-	-	-	-	I
<i>Veronica chamaedrys</i>	-	-	-	-	-	-	-	+	-	-	-	I
<i>Fragaria vesca</i>	+	-	-	+	+	+	+	+	-	+	+	III
<i>Stachys alpina</i>	-	-	-	-	-	-	+	-	-	-	-	I
<i>Senecio ovatus</i>	+	+	-	-	-	-	+	-	-	-	-	II
<i>Brachyctenium velutinum</i>	-	-	-	-	-	+	+	-	-	-	-	I
<i>Hylocomnium splendens</i>	-	-	-	-	-	+	+	-	-	-	-	I
<i>Rubus idaeus</i>	+	+	-	-	-	-	-	-	-	-	-	II
<i>Cruciata pedemontana</i>	-	+	-	-	-	-	-	-	-	-	-	I
<i>Sambucus racemosa</i>	-	+	-	-	-	-	-	-	-	-	-	I
<i>Anthriscus racemosus</i>	-	+	-	-	-	-	-	-	-	-	-	I

Relevé site and date: 1 Jgheabul Oilor 31.07.04; 2 "Lutul Roșu" 02.08.04; 3 La Scaune 03.07.05; 4 Izvorul Alb spring 10.09.69; 5 Stâncea Curmăturii 08.08.68; 6 La Duruitoarea 09.08.68; 7 Chica Fântânelelor 12.08.68; 8 Pictorul dintre Bistre 08.08.69; 9 Obcina Lacurilor 17.08.69; 10 Piatra Sură 18.08.69

Table 3

Ass. *Leucanthemo waldsteinii*-*Piceetum* Krajina 1933

	1	2	3	4	5	6	7	8	9	10	K
Altitude (m)	1790	1720	1700	1190	1180	1170	1180	1225	1165	1240	
Exposition	E	E	E	N	NE	NE	V	NV	NV	NV	
Slope (degrees)	30	40	35	15	30	35	10	35	5	35	
Tree layer cover (%)	70	80	75	85	85	90	85	80	85	80	
Shrubs + juveniles cover (%)	5	5	5	10	10	5	5	5	15	5	
Grass layer cover (%)	90	90	85	70	50	60	70	50	90	50	
<i>Hieracium transsilvanicum</i>	+	+	-	+	+	-	+	+	+	+	IV
<i>Piceion excelsae</i>	+	+	2	1	+	+	4	2	4	1	V

Hieracium transsilvanicum

Luzula sylvatica

Relevé number

<i>Dryopteris dilatata</i>	+	-	+	1	+	+	7	8	9	10	K
<i>Athyrium distentifolium</i>	-	-	+	1	1	-	+	1	+	+	V
<i>Calamagrostis villosa</i>	-	-	+	-	-	-	-	-	-	-	I
<i>Phegopteris conecitilis</i>	-	-	+	-	+	+	+	+	+	+	III
<i>Corallorrhiza trifida</i>	-	-	-	-	-	-	-	-	+	+	I
<i>Clematis alpina</i>	-	-	-	-	-	-	-	+	+	-	I
<i>Veronica officinalis</i>	+	-	+	-	+	+	+	-	-	-	III
<i>Monotropa hypopitys</i>	-	-	-	-	-	-	-	-	-	-	I
<i>Dicranum scoparium</i>	-	-	-	-	-	-	-	-	+	+	I
<i>Chaerophyllum hirsutum</i>	+	-	1	+	-	-	-	+	-	+	III
<i>Hypnum cupressiforme</i>	-	-	-	-	-	-	-	+	+	-	I
<i>Ranunculus carpaticus</i>	+	+	+	+	+	+	+	+	+	+	IV
<i>Luzula luzuloides</i>	+	+	+	1	+	+	+	+	+	+	V
<i>Calamagrostis arundinacea</i>	+	+	+	+	+	+	+	+	+	+	IV
<i>Picea abies</i>	5	4	4	5	5	5	5	5	5	5	V
<i>Abies alba</i>	-	-	+	+	+	+	+	+	+	+	IV
<i>Sanicula europaea</i>	-	-	-	+	-	-	+	+	+	+	III
<i>Corylus avellana</i>	-	-	-	-	-	+	+	-	+	+	II
<i>Leucanthemum waldsteinii</i>	-	-	-	-	-	-	+	-	+	+	IV
<i>Veratrum album</i> var. <i>lobelianum</i>	+	+	+	+	+	+	+	+	+	+	IV
<i>Streptopus amplexifolius</i>	-	+	+	+	-	-	-	+	-	+	II
<i>Daphne mezereum</i>	-	-	+	+	-	+	+	+	+	+	IV
<i>Polystichum lonchitis</i>	-	+	-	-	+	-	-	+	+	+	III
<i>Athyrium filix-femina</i>	+	-	+	+	+	+	+	+	+	+	V
<i>Valeriana tripteris</i>	-	-	+	-	+	+	-	-	+	+	II
<i>Rosa pendulina</i>	-	-	-	-	-	+	+	-	+	-	I
<i>Mercurialis perennis</i>	+	-	-	-	+	+	+	+	1	1	III
<i>Hypericum maculatum</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Astrantia major</i>	-	+	+	-	-	+	+	-	-	-	II
<i>Dryopteris carthusiana</i>	-	-	+	+	-	+	-	-	-	+	II,
<i>Sorbus aucuparia</i>	+	-	+	+	+	+	+	+	+	+	V
<i>Lonicera nigra</i>	+	+	+	+	-	-	-	+	+	-	II
<i>Campanula abietina</i>	+	+	+	+	+	+	+	-	+	+	V
<i>Luzula pilosa</i>	-	-	-	+	+	+	-	-	-	+	II
<i>Oxalis acetosella</i>	+	+	-	1	2	2	2	2	2	2	V
<i>Homogyne alpina</i>	+	-	+	+	-	-	-	+	-	-	II

Dicrano – Pinion

Piceetalia excelsae

Abieti – Piceion

Chrysanthemo – Piceion

Athyrio – Piceetalia

Vaccinio – Piceetea

Relevé number

	1	2	3	4	5	6	7	8	9	10	K
<i>Vaccinium myrtillus</i>	-	+	-	-	-	+	-	-	-	+	I
<i>Vaccinium vitis-idaea</i>	-	-	-	-	+	-	-	+	-	+	I
<i>Gymnocarpium dryopteris</i>	-	-	+	-	-	-	+	-	-	-	II
<i>Moneses uniflora</i>	-	-	-	-	-	-	-	-	-	-	I
<i>Goodyera repens</i>	-	-	-	-	+	+	-	-	-	+	II
<i>Lycopodium selago</i>	-	-	-	+	+	-	-	+	+	+	III
<i>Orthilia secunda</i>	-	-	+	-	-	-	+	+	+	+	V
<i>Circaea alpina</i>	+	+	+	+	+	+	+	+	+	+	I
<i>Lycopodium annotinum</i>	-	-	-	-	-	+	-	-	-	-	I
Quercus - Fagetes											
<i>Acer pseudoplatanus</i>	-	-	+	+	+	+	+	-	+	+	IV
<i>Dentaria glandulosa</i>	-	+	-	-	-	+	-	+	+	+	III
<i>Veronica urticifolia</i>	+	+	+	+	+	+	-	+	+	+	IV
<i>Mycelis muralis</i>	-	-	+	+	+	+	+	+	+	+	IV
<i>Myosotis sylvatica</i>	-	-	+	+	+	+	+	+	+	+	V
<i>Lamium galeobdolon</i>	-	-	+	-	-	-	-	+	+	+	II
<i>Dryopteris filix-mas</i>	-	-	+	+	I	I	+	+	+	+	IV
<i>Symphytum cordatum</i>	-	-	-	-	+	-	+	+	+	-	II
<i>Moehringia trinervia</i>	-	-	-	+	+	+	-	-	-	+	II
<i>Veronica montana</i>	-	+	-	-	-	+	-	-	-	+	I
<i>Primula elatior ssp. leucophylla</i>	+	+	+	-	-	-	-	-	-	-	II
<i>Cardamine impatiens</i>	-	+	+	+	+	+	-	-	-	+	IV
<i>Salvia glutinosa</i>	-	-	+	+	+	+	+	+	+	+	IV
<i>Euphorbia amygdaloides</i>	-	-	-	-	+	+	+	+	+	-	II
<i>Polystichum aculeatum</i>	+	-	+	-	+	-	-	-	-	-	II
<i>Pulmonaria rubra</i>	-	-	-	-	+	+	-	-	-	-	I
<i>Galium schultesii</i>	-	-	+	+	-	+	-	-	+	+	I
<i>Fagus sylvatica</i>	-	-	+	+	+	+	+	-	+	+	III
<i>Carex digitata</i>	-	-	-	-	-	+	-	-	-	+	I
<i>Hepatica transsilvanica</i>	-	-	-	-	-	+	-	-	+	-	I
<i>Anemone nemorosa</i>	-	-	-	-	-	+	-	-	+	-	I
<i>Acer platanoides</i>	-	-	-	-	-	+	-	-	-	-	I
<i>Aquilegia vulgaris</i>	+	+	-	-	-	-	-	-	-	-	I
<i>Cruciata glabra</i>	+	+	-	-	-	-	-	-	-	-	II
<i>Poa nemoralis</i>	+	+	+	-	+	-	-	+	-	-	II
<i>Galeopsis spectiosa</i>	-	-	-	+	+	-	-	+	-	-	II
<i>Galium odoratum</i>	-	-	-	+	+	-	+	+	-	-	II
<i>Ulmus glabra</i>	-	-	-	-	-	-	+	+	-	+	I
<i>Rubus hirtus</i>	-	-	-	-	-	+	-	-	-	+	I
<i>Paris quadrifolia</i>	-	-	+	-	-	-	-	-	-	+	I
<i>Viola reichenbachiana</i>	-	-	-	-	-	-	+	-	-	+	I
<i>Actaea spicata</i>	-	-	-	+	+	-	-	-	-	-	I

Relevé number	1	2	3	4	5	6	7	8	9	10	K
<i>Epilobium montanum</i>	-	-	-	+	+	-	-	+	-	-	II
<i>Ajuga reptans</i>	-	-	+	-	-	+	-	-	-	-	I
<i>Isopyrum thalictroides</i>	-	-	-	-	-	-	-	-	+	-	I
<i>Carex sylvatica</i>	-	-	-	-	-	-	-	-	+	-	I
<i>Brachypodium sylvaticum</i>	-	-	-	+	-	-	-	-	-	-	I
<i>Geum urbanum</i>	-	-	-	+	-	-	-	+	-	-	I
<i>Asplenietea et Thlaspietea</i>											
<i>Asplenium ramosum</i>	-	-	-	+	+	-	+	-	-	-	II
<i>Polypodium vulgare</i>	-	-	-	+	+	-	-	-	-	-	I
<i>Asplenium ruta-muraria</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Campanula carpatica</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Spiraea chamaedryfolia</i>	-	-	-	+	-	-	-	-	-	-	I
<i>Asplenium trichomanes</i>	-	-	-	+	+	-	-	-	-	-	I
<i>Epilobium collinum</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Cardaminopsis arenaria</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Saxifraga paniculata</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Saxifraga aizoides</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Cystopteris fragilis</i>	+	-	-	+	-	-	-	-	-	-	I
<i>Arabis alpina</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Mulgedio-Aconitea</i>											
<i>Gentiana asclepiadea-</i>	-	-	+	-	-	+	-	+	-	+	II
<i>Corthusa matholi</i>	+	-	+	-	-	+	-	-	-	-	II
<i>Doronicum carpaticum</i>	-	-	-	-	-	+	-	-	-	+	I
<i>Ribes alpinum</i>	-	-	-	-	-	-	+	-	-	-	I
<i>Polygonatum verticillatum</i>	-	+	+	-	-	+	+	-	+	+	III
<i>Stachys sylvatica</i>	-	+	+	+	-	+	+	-	+	+	III
<i>Crepis paludosa</i>	-	-	-	-	-	-	-	-	-	+	I
<i>Stellaria nemorum</i>	5	5	5	-	+	+	+	-	-	+	IV
<i>Adenostyles alliariae</i>	+	+	+	-	-	-	-	-	-	-	II
<i>Milium effissum</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Poa chaixii</i>	-	+	+	-	-	-	-	-	-	+	II
<i>Doronicum austriacum</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Galio-Urticetea</i>											
<i>Geranium robertianum</i>	+	-	+	+	-	+	+	+	+	+	IV
<i>Urtica dioica</i>	-	-	-	+	+	+	-	+	+	+	III
<i>Chrysosplenium alternifolium</i>	-	-	-	+	-	-	-	-	-	-	I
<i>Tussilago farfara</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Circaea lutetiana</i>	+	+	+	-	+	+	-	-	-	-	III
<i>Chaerophyllum aureum</i>	-	+	+	-	-	-	+	-	-	+	II
<i>Chaerophyllum temulum</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Aegopodium podagraria</i>	-	-	-	-	-	-	-	-	+	+	I
<i>Impatiens noli-tangere</i>	-	-	-	-	-	+	-	-	-	+	II

Relevé number	1	2	3	4	5	6	7	8	9	10	K
	<i>Molinio-Arrhenatherethea</i>										
<i>Rumex acetosa</i>	+	+	-	-	-	-	-	-	-	-	I
<i>Ranunculus repens</i>	+	+	+	-	-	-	-	-	-	-	II
<i>Poa pratensis</i>	+	-	+	-	-	-	-	-	-	-	I
<i>Alchemilla vulgaris agg.</i>	+	+	+	-	-	-	-	-	-	-	II
<i>Sagina procumbens</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Campanula glomerata</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Epilobium hirsutum</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Campanula patula</i>	-	-	-	-	+	-	-	-	-	-	I
	<i>Variae syntaxa</i>										
<i>Veronica chamaedrys</i>	-	+	+	-	-	-	-	-	-	-	I
<i>Fragaria vesca</i>	+	+	+	+	+	+	+	+	+	+	V
<i>Stachys alpina</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Senecio ovatus</i>	+	+	+	+	+	+	-	+	+	+	V
<i>Rubus idaeus</i>	+	+	+	1	1	+	+	+	+	+	V
<i>Cruciata pedemontana</i>	+	-	-	-	-	-	-	-	-	-	I
<i>Sambucus racemosa</i>	-	+	+	1	+	+	-	+	-	-	III
<i>Anthriscus racemosus</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Ranunculus oreophyllus</i>	-	+	-	-	-	-	-	-	-	-	I
<i>Chamaerion angustifolium</i>	-	-	-	-	+	-	-	-	-	-	II

Relevés site and date: 1-3 base of Toaca
02.08.04; 4-6 Piciorul Săhastru 17.08.04; 7 La
Cerebuc 02.07.05; 8-10 La Scaune 03.07.05.

CONCLUSIONS

We found the three types of phytocoenoses at the following altitudes: *Hieracio transsilvanico-Piceetum* between 1010 m and 1550 m, *Leucanthemo waldsteinii-Piceetum* between 1165 m and 1790 m, and *Soldanello montanae-Piceetum* between 1550 m and 1820 m.

The covering reached by the grass layer in the investigated associations is dissimilar: 5–15 % for *Soldanello montanae-Piceetum*, 5–20 % for *Hieracio transsilvanico-Piceetum*, and 70–90 % for *Leucanthemo waldsteinii-Piceetum*. The high percentage of the third associations is due to the lower acidity of the substratum.

The superior coenotaxa are well represented, which demonstrates the correct coenotaxonomical classification.

All the three types of phytocoenoses, but mostly the lower altitude communities that border the upper limit of the beech forests are rich in deciduous forest species.

In the rocky valleys and along the streams many species of the class *Mulgedio-Aconietea* grow.

REFERENCES

1. Burduja C., 1968, *Muntele Ceahlău. Flora și vegetația*. Ocrot. nat., București, 6: 63–92.
2. Cernescu N., 1934, *Facteurs de climat et zones de sol en Roumanie*. Imprimeria Națională, București, 71 p.
3. Chifu T., Mititelu D., Dăscălescu D., 1987, *Flora și vegetația județului Neamț*. Mem. Sect. șt. Acad. Rom. Seria IV, 10(1): 281–302.
4. Chifu T., Ștefan N., 1992, *Contributions to the spruce fir forest study in the Călimani mountains*. An. Șt. Univ. "Al. I. Cuza" Iași (Serie nouă), s. II-a. Biol. veget., 38: 45–51.
5. Grințescu I., 1924, *Consideration géobotaniques sur le mont Ceahlău (Carpates Orientales)*. Bul. Soc. St. Cluj, 2(2): 104–112.
6. Nyarady E., 1924, *Contribuții la cunoașterea vegetației și florei muntelui Ceahlău*. Bul. Grăd. Bot. și Muz. Bot. Cluj, 4: 2–3.
7. Pop I., Cristea V., Hodișan I., 2002, *Vegetația județului Cluj (Studiu fitocenologic, ecologic, bioeconomic și eco-protectiv)*. Contrib. bot. (1999–2000). Cluj-Napoca, 35: 5–254.
8. Răvărui M., 1936, *Noutăți din flora Muntelui Ceahlău, Distr. Neamț*. Bul. Grăd. Bot. Muz. Bot. Univ. Cluj, 16 (1–4): 78–85.
9. Sanda V., Popescu A., Stanca D., 2001, *Structura cenotică și caracterizarea ecologică a fitocenozelor din România*. Edit. Conphis.
10. Zamfirescu O., Chifu T., 2003, *Contributions to the study of class Vaccinio-Piceetea Br.-Bl. 1939 from the Oriental Carpathians*. Contr. bot., 1, Cluj-Napoca, 38: 37–46.7.
11. Zanoschi V., 1971, *Flora și vegetația masivului Ceahlău*. Doctorate thesis. Cluj-Napoca.

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