CONTRIBUTIONS TO THE PHYTOCOENOLOGICAL STUDY OF THE BEECH FORESTS OF THE *LUZULO-FAGETUM* TYPE IN THE ORAŞTIE RIVER BASIN (CENTRAL-WESTERN ROMANIA)

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Abstract. In the current paper we present a phytocoenologic study of the phytocoenoses of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 (Syn.: *Hieracio rotundati-Fagetum* (Vida 1963) Täuber 1987, *Dechampsio flexuosae-Fagetum* Soó 1962, *Luzulo-Fagetum silvaticae* (Beldie 1951) Morariu *et al.* 1968) identified in the acidophylous beech forests of the Orăştie river basin, situated in the central-western part of Romania.

The characterisation of the association under analysis as well as the presentation of the synthetic table have been done by selecting the most representative relevées performed in the beech forests of the *Luzulo-Fagetum* type belonging to the Orăştie river.

The phytocoenoses of these beech forests were analysed in terms of physiognomy and floristic composition, life forms spectrum, floristic elements, and ecological indices.

Keywords: phytocoenoses, association, relevée, floristic elements, life forms, ecological indices, Orăştie river basin.

INTRODUCTION

The hydrographic basin of the Orăştie river lies in the central-western part of Romania (Fig. 1). It is located between the hydrographic basins of the rivers Strei (to the South and West) and Cugir (to the East), while to the North the Oraştie river discharges into the Mureş river [34, 36].

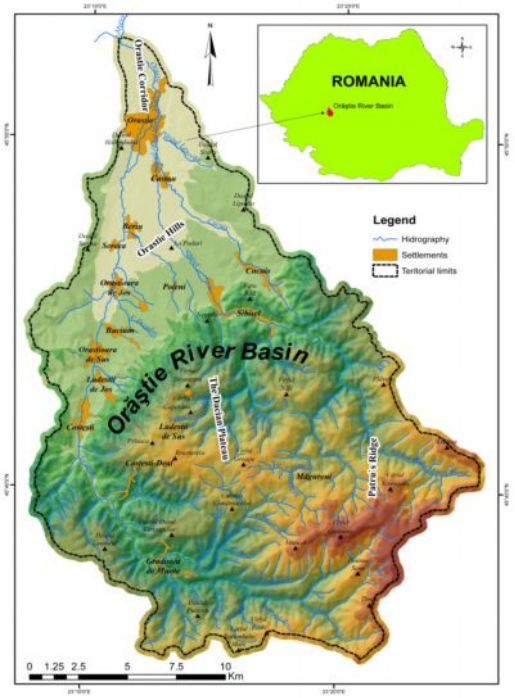

Figure 1. Position of Orăştie River Basin in Romania [38]

The Şureanu Mountains belong to the greater unit of the Southern Carpathians, Parâng Mountains Group, as an orographically distinct mountainous ensemble, framed by the rivers Olt, Jiu, and Strei. We must add that within the studied territory only a fraction of the Şureanu Mountains is included, namely the west-north-western one commonly known as the Orăştie Mountains or the Sarmizegetusa Mountains or the Mountains of the Dacian Fortresses [34]. The highlands of the Orăştie river basin, where the phytocoenoses of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 have been identified, lie between the altitudes of 560 m and 1656 m (Godeanu Peak).

The Şureanu Mountains consist mainly of meso-metamorphic and epi-metamorphic schists surrounded peripherically by some areas of sedimentary rocks (sandstones, conglomerates, limestones etc.) [34].

The territory under analysis is part of the temperate climatic zone, the continental type, the maritime influenced climatic sector, the Southern Carpathians subdivision, the complex topoclimate of the Orăştie lowlands and Parâng highlands [34].

The thermal differences between the outskirts of the mountains and the high ridges are of roughly 10ºC on average. Towards their north-western limits, due to warm air incursions from the Western Plains, the average temperatures range from 9 to 10ºC [34]. In winter, the average temperatures vary between minus 2 and minus 7ºC, in spring they rise by 6 to 12ºC, in summer they reach 8ºC on the mountain tops and over 19ºC on the outskirts, while in autumn the average temperatures decrease by 5.5 to 7ºC as compared to those in the summer months [34].

The multiannual average of rainfall amounts is approximately 550-600 mm in the outskirts and to over 1000 mm in the high altitude central parts [34]. In the whole of Transylvania the rainfall quantum is 500 to 700 mm per year [17].

The association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 is widespread in the Romanian Carpathians, it being previously described in the Eastern, Southern and Western Carpathians [9, 10, 18-20, 24, 25, 29].

The association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, (Fig. 2) has a significantly large occurrence in the European beech forests belonging to the Orăştie river basin. In the territory under scrutiny we found other forest associations as well: *Carpino-*

Fagetum Paucă 1941, *Symphyto cordati-Fagetum* Vida 1963, *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, *Festuco drymejae-Fagetum* Morariu *et al.* 1968.

Figure 2. Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 (Bunei - Sibişelului Valley)

MATERIALS AND METHODS

The vegetation studies of the catchment basin of the Orăştie river (central-western Romania) were carried out between the years of 2010 and 2011 targetting all types of sites indicative of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964) [3], adjusted according to the particularities of the studied region. The sampling technique and the annotations (quantitative appraisals) were performed according to the indications given by Borza et Boşcaiu (1965) [1]. The associations were identified using the characteristic species, without neglecting the differential and dominant species [1, 5].

In order to thoroughly identify the phytocenoses of the association, we performed a total of 25 phytocoenologic sampling incursions or relevées, of which 10 relevées were included in the synthetic table of the association (Table 1), the other 15 having been excluded from the table since they displayed similar stational conditions. In order to perform the sampling relevées, areas of 400 square metres were selected, as homogeneous as possible with respect to floristic composition, landforms, geology, slope exposition, while the ecotone areas were avoided [1,5].

The phytocoenologic worksheets contain information regarding the stational habitat conditions in which the phytocenoses evolve: rock, soil, altitude, exposition, slope, vegetation coverage. At the same time when we took down the taxa that define each relevée, we also gave a quantitative appraisal of the participation of each and every species with respect of abundance and dominance, in accordance with the method proposed by Braun-Blanquet et Pavillard (1928) [2], and we filled in the overall vegetation coverage using the method designed by Tüxen (1955) [35] and Ellenberg (1974) [11].

The phytocoenologic table of the association was structured according to the methodology designed by Braun-Blanquet (1964) [3] and improved by Ellenberg (1974) [11]. The methodology we used for positioning the association into the superior coeno-taxonomic units, namely suballiance, alliance, order, class, took into consideration the traditional ecological-floristic systems developed by Tüxen (1955) [35], Braun-Blanquet (1964) [3], Borza et Boşcaiu (1965) [1], Soó (1980) [31], as well as the more recent papers by researchers such as Mucina *et al.* (1993) [14], Pott (1995) [23], Weber *et. al.* (2000) [37], Sanda (2002) [27], Sanda *et. al* (2008) [30]. In order to position the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 (analysed by us in this paper) into the superior coeno-taxonomic units we referred to Sanda *et al.* (2008) [30].

The constance of species (K) whose classes are marked by Roman digits from I to V, stands for the degree of coenotic fidelity of each species towards the ambient of the association phytocoenoses. The average abundance-dominance (ADm) stands for the percentage of each species phyto-individual mean coverage within the phytocoenoses. The values of the synthetic phytocoenologic indices, constance (K) and average abundance-dominance (ADm), were calculated using the methods proposed by Braun-Blanquet et Pavillard (1928) [2], Cristea *et al.* (2004) [5].

The nomenclature of taxa was done according to Ciocârlan (2009) [4], and the vegetal association was analysed using the main ecological indices of the component species, life forms and floristic elements, the data being shown graphically in spectra and diagrams [5, 28].

RESULTS

The phytocoenoses of the association were identified in the following places: Bunei (Sibişelului Valley), Feţele Albe (Grădiştei Valley), Muncel (Grădiştei Valley), Lunca Mare (Grădiştei Valley), Pârâul Crişan (Grădiştei Valley), Tihu (Grădiştei Valley), Anineşu (Anineşului Valley), Izvorele (Anineşului Valley), Prislop (Sibişelului Valley), Meleia (Grădiştei Valley).

The beech forests with *Luzula luzuloides* can be found on slopes with discrete exposition (S, E, W, SE, SW), with a drop of 18° - 46°, at altitudes of 760-1370 m (Table 1), covering oligobasic brown soils (dystricambosoils), developed on crystalline schists as a rule.

The physiognomy and the floristic composition. These are natural quasi-pristine forests, with trees 100-170 years old and wood trunks felled by hazards (4-8%) and decayed (Fig. 2). The floristic inventory of European beech forests with *Luzula luzuloides* totals 99 species, which underlines a rich biodiversity. Out of the total number of species, 72 of them all (72.72%) belong to the coenotaxa subordinating the association,

and 27 species (27.27%) are transgressive from and adjacent to other associations.

The tree layer is dominated by *Fagus sylvatica* subsp. *sylvatica*, accompanied sporadically by: *Acer pseudoplatanus*, *Abies alba*, *Cerasus avium*, *Acer platanoides*, *Carpinus betulus*, *Fraxinus excelsior*, *Quercus polycarpa, Picea abies*, *Tilia cordata*. The canopy coverage is around 0.7-0.9. The trunk diameters vary between 41 and 70 cm, while they rise up to 24 - 32 m tall.

The undergrowth and the offspring cover roughly 10% - 15% of the area and consist of the following species: *Fagus sylvatica* subsp. *sylvatica*, *Acer pseudoplatanus*, *Abies alba*, *Cerasus avium*, *Carpinus betulus*, *Fraxinus excelsior*, *Acer platanoides*.

The undergrowth species, unevenly dispersed in the wooded area, consist of the following: *Corylus avellana*, *Rosa canina*, *Rubus idaeus*, *Daphne mezereum*, *Vaccinium myrtillus*, *Rubus hirtus* subsp. *hirtus*.

The herbaceous layer with a coverage of 10% to 80%, is dominated by *Luzula luzuloides*, the characteristic species and the one that defines the association. The rest of this sinusia's spectrum of species subordinates to the **suballiance *Calamagrostio-Fagenion*** Boşcaiu *et al.* 1982 (*Calamagrostis arundinacea*, *Deschampsia flexuosa*, *Blechnum spicant*, *Veronica officinalis*, *Pteridium aquilinum*) then to the **alliance *Symphyto cordati-Fagion*** Vida 1959 (*Veronica urticifolia*, *Pulmonaria rubra*), after that to the **order *Fagetalia sylvaticae*** (*Galium odoratum*, *Mercurialis perennis*, *Hieracium transsylvanicum*, *Oxalis acetosella*, *Galeobdolon luteum*, *Asarum europaeum*) and finally to the **class *Querco-Fagetea*** Br.-Bl. et Vlieger in Vlieger em. Borhidi 1996, among them worth mentioning are the species displaying a greater value of the (K) constance: *Athyrium filix-femina*, *Prenanthes purpurea*, *Circaea lutetiana*, *Dentaria bulbifera*, *Mycelis muralis*, *Lapsana communis*, *Festuca drymeja*, *Poa nemoralis*.

The life forms spectrum of the association under consideration (Fig. 3) highlights the numerical prevalence of hemicryptophytes (H = 56.56%), their abundence being largely influenced by the mild temperate climate, and the natural hazards (trees felled by wind and snow). The hemicryptophytes are closely followed by phanerophytes (Ph = 19.19% of which: MPh = 10.10%, mPh = 4.04%, nPh = 5.05%) as they are the basic constituents of forests. The geophytes (G = 12.12%) share a small percentage and illustrate the presence of a habitat where these species round up their short vegetation cycle in early spring and spring. The therophytes (Th + TH = 8.08%) with a poor percentage, illustrate a low anthropic impact on flora and vegetation. The chamaephytes (Ch = 4.04%), with a very thin presence, appear only occasionally in the phytocoenoses of this association.

The floristic elements spectrum (Fig. 4) reveals the prevalence of the Eurasian species (Eua = 38.38%), followed by those European (E = 23.23%), with their genetic centre in the regions with a mild temperate climate of Europe, and those Central-European (Ec = 14.14%), with their genetic centre in the regions with a mild and wet climate of Europe, from where they transgressed to the more continental regions, including the Orăştie river basin. The Circumpolar elements (Cp = 9.09%), and those Alpino-Carpathian (Alp-Carp = 1.01%) are present in a small share, extant only in the forest stands with climatic conditions similar to those of the Boreal zone. The existence of southern elements, Atlantic-Mediterranean (Atl-M = 2.02%) and Pontic-Mediterranean (P-M = 1.01%), is due to the frequent warm air incursions through the Mureşului Corridor and the Orăştiei Corridor, originating in the Mediterranean Sea. It is also worth mentioning the presence in the territory under consideration of the Balkan-Carpathian elements (Carp-B = 6.06%), which are characteristic of the Carpathian and Balkan Mountains, the Carpathian elements (Carp = 1.01%), which are characteristic of the Carpathian Mountains, and the Cosmopolitan elements (Cosm = 4.04%) with the largest representation worldwide.

The analysis of the diagram of ecological indices (Fig. 5) reveals a majority of mesophylous species ($U_{3-3.5}$ = 64.64%), followed by xero-mesophylous species ($U_{2-2.5}$ = 16.16%), meso-hygrophylous ($U_{4-4.5}$ = 14.14%), hygrophylous ($U_{5-5.5}$ = 1.01%), xerophylous (1.01) and eurihydrophylous (U_0 = 3.03%). If analysed thermically, one can notice the dominance of mesothermophylous species ($T_{3-3.5}$ = 63.63%), followed by microthermophylous ($T_{2-2.5}$ = 22.22%), cryophylous ($T_{1-1.5}$ = 1.01%) and eurithermophylous (T_0 = 13.13%).

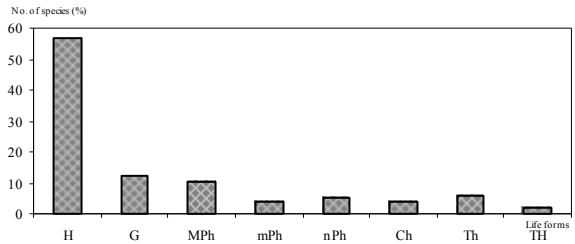

Figure 3. Life forms spectrum of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch- Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual therophytes; TH – Biannual therophytes.

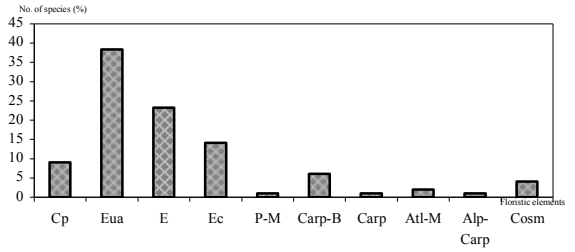

Figure 4. Spectrum of floristic elements for the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; P-M – Pontic-Mediterraneean; Carp-B - Balkan-Carpathian; Carp – Carpathian; Atl-M - Atlantic-Mediterraneean; Alp-Carp – Alpino- Carpathian; Cosm – Cosmopolitan.

The presence of dystricambosoils reflect a high percentage of acid-neutrophylous species (R_3 = 34.34%), followed by those weakly acid-neutrophylous (R_4 = 23.23%), acidophylous (R_2 = 10.10%), strongly acidophylous (R_1 = 3.03%) and euri-ionical (R_0 = 27.27%). Upon analysing the diagram below it goes that the phytocoenoses of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, are mesophylous, micro-mesothermophylous and acid-neutrophylous.

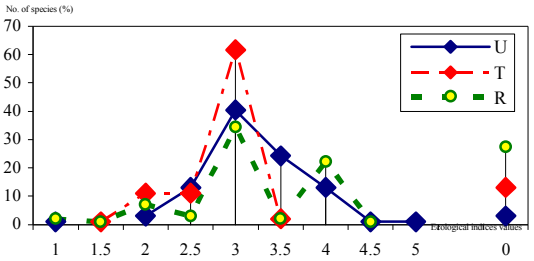

Figure 5. Diagram of ecological indices for the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: U - humidity, T - temperature, R - the chemical reaction of the soil.

DISCUSSIONS

The studies we carried out between 2010 and 2011 have shown that the *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 association, summing up the acidophylous beech forests, is well represented in the Orăştie river basin (Şureanu Mountains). The above-mentioned association from this geographic region of Romania, analysed herein, is stable as to the ecological dynamics and equilibrium, and has not been previously analysed by other authors.

In the acidophylous beech forests from the Orăştie river basin we identified plant species included in the red lists: endangered (*Cephalanthera longifolia*), rare (*Doronicum carpaticum*) and Tertiary relics (*Blechnum spicant*) [4, 6, 15, 16, 32]. The forests consisting of populations of threatened and endangered species are of importance in preserving the biodiversity values, hence must be cared for accordingly [41].

The phytocoenosis of the *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 association in the Cernei de Olteţ river basin (Căpăţânii Mountains), analysed by Răduţoiu (2008) [25] and that can be found at altitudes of 500–850 m, consist of ligneous species characteristic of the ***Quercion frainetto*** I. Horvat nom. mut. propos. **alliance** (associating species of continental xerothermal oaks) [30], which prefer the warmer climates: *Quercus frainetto, Quercus dalechampii, Tilia tomentosa* [33]. The absence of these species in the phytocoenoses studied herein in the Orăştie river basin (Şureanu Mountains) is determined by the higher altitudes (760–1370 m) in this territory, altitudes at which the above mentioned species no longer found propitious stations for their growth, the colder and wetter climate in the Orăştie river basin (Şureanu Mountains) favouring instead the development of some species characteristic of the ***Vaccinio-Piceetea*** Br.-Bl. in Br.-Bl. *et al.* 1939 **class**, *Picea abies* and *Vaccinum myrtillus* which are not present in the similar phytocoenoses of the Cernei de Olteţ river basin (Căpăţânii Mountains).

In the Cernei de Olteţ river basin (Căpăţânii Mountains) a few herbaceous plant species can also be found, namely: *Festuca heterophylla*, *Melampyrum bihariense*, *Melittis melissophyllum*, *Carex pilosa*, which are characteristic of the ***Lathyro hallersteinii-Carpinenion*** Boşcaiu *et al.* 1982 **suballiance** [30], coenotaxa that are not present in the phytocoenosis of the similar association from the Orăştie river basin (Şureanu Mountains). These herbaceous species, xerophile, xero-mesophile, micro-mesothermal which vegetate on dry-wet to wet soils, in stations with a lesser and only seasonal humidity deficit i.e. sunny slopes, thrive in favourable vegetating conditions in the Cernei de Olteţ river basin (Căpăţânii Mountains), Oltenia's milder climate significantly influencing the Căpăţânii Mountains too [22].

The ligneous species *Fagus sylvatica* subsp. *sylvatica*, which is a trait for the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, stretches upward to the altitude of 1370 m in the Orăştie river basin (Şureanu Mountains), whereas on the Codlei Massif (Curvature Carpathians) it occurs up to the altitude of 950 m [13]. The isolation of the Codlei Massif, with its rocky slopes, gentle drainage of the runoff, upwind exposition, are considered hindrances against the expansion of the beech species to the peak [13].

The highly acidophylous and acidophylous species (*Vaccinum myrtillus*, *Calamagrostis arundinacea*, *Luzula luzuloides*) have a higher constance and dominance in the phytocoenosis of the *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 association from the Codlei Massif (Curvature Carpathians) than the similar species from the Orăştie river basin (Şureanu Mountains). Based on dominance, Morariu *et. al* (1968) describes three facies representing distinct evolutionary phases of the association: the facies with *Vaccinum*, the facies with *Calamagrostis* and the facies with *Luzula* [13]. The conclusion that can be drawn is that the soils where the phytocoenosis of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, described by Morariu *et. al* (1968) have spread, aren't offering such propitious conditions for the vegetation as those in the Orăştie river basin (Şureanu Mountains).

Doniţă *et. al* (2005) states that the *Luzulo-Fagetum* type forests (Natura 2000: 9110 *Luzulo-Fagetum* beech forest) which shelter the phytocoenosis of the *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 association are widespread in the Romanian Carpathians, particularly on acidic rock mountains, having a moderate conservation value [7, 8, 26].

The acidophylous character of the beech forests in the Orăştie river basin is accounted for by a significant number of acidophylous species (*Luzula luzuloides*, *Calamagrostis arundinacea*, *Veronica officinalis*, *Hieracium umbellatum*, *Campanula abietina*, *Luzula sylvatica*), growing on highly acid to medium acid

Table 1. Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 in Orăştie River Basin

L.f.	F.e.	U.	T.	Sr.	No. relevées	1	2	3	4	5	6	7	8	9	10	K	ADm (%)
					Altitude (m.s.m.)	790	1300	1350	830	810	760	930	1100	980	1370		
					Exposition	SE	S	E	SW	SE	W	S	S	SW	W		
					Slope (º)	46	20	20	40	42	43	18	41	22	20		
					Hight of the trees (m)	24	25	26	29	30	32	25	26	30	32		
					Trunk diametres (cm)	60	70	60	56	64	54	48	44	41	64		
					Consistency of tree layer (%)	0.7	0.7	0.7	0.7	0.7	0,7	0.7	0.7	0.7	0.9		
					Herbaceous cover layer (%)	35	30	30	35	50	30	75	35	80	10		
					Surface (m^2)	400	400	400	400	400	400	400	400	400	400		
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
MPh	E	3	3	0	*Fagus sylvatica* subsp. *sylvatica*	4	4	4	4	4	4	4	4	4	5	V	68.75
H	E	2.5	2.5	2	*Luzula luzuloides*	2	2	2	2	3	2	1	2	3	1	V	19.00
					Calamagrostio-Fagenion												
H	Eua	2.5	3	2	*Calamagrostis arundinacea*	+	+	+	+	+	.	.	.	+	+	IV	0.35
H	Cp	2	0	1	*Deschampsia flexuosa*	.	+	.	.	.	.	+	.	1	.	II	0.70
H	Cp	3.5	2	1.5	*Blechnum spicant*	.	.	.	.	.	.	+	.	.	.	I	0.05
Ch	Eua	2	2	2	*Veronica officinalis*	.	+	+	.	.	.	.	.	.	.	I	0.10
G	Cosm	3	3	0	*Pteridium aquilinum*	.	.	.	+	.	.	.	.	.	.	I	0.05
					Symphyto cordati-Fagion												
MPh	Ec	3.5	3	3	*Acer pseudoplatanus*	1	+	.	+	.	.	.	+	+	.	III	0.70
MPh	E	3	3	3	*Carpinus betulus*	+	.	.	.	+	+	.	.	.	.	II	0.15
H	Ec	3	2.5	4	*Veronica urticifolia*	.	.	.	+	.	+	.	+	.	.	II	0.15
H	Carp-B	3.5	2	3	*Pulmonaria rubra*	.	.	.	+	+	.	.	.	.	.	I	0.10
H	Ec	4	2	4	*Gentiana asclepiadea*	.	.	.	+	.	.	.	.	.	.	I	0.05
					Fagetalia sylvaticae												
G	Eua	3	3	3	*Galium odoratum*	1	.	.	+	+	+	.	1	.	+	III	1.15
H	E	3.5	3	4	*Mercurialis perennis*	.	.	.	+	+	1	.	+	+	.	III	0.70
H	Carp-B	3	0	0	*Hieracium transsylvanicum*	+	.	.	+	+	+	+	.	+	.	III	0.30
nPh	E	3	2.5	3	*Rubus hirtus* subsp. *hirtus*	.	+	+	.	.	+	.	+	.	+	III	0.25
H	Cp	4	3	3	*Oxalis acetosella*	.	+	1	.	.	.	.	.	.	+	II	0.60
H	Ec	3	0	4	*Galeobdolon luteum*	.	.	.	+	+	+	.	+	.	.	II	0.20
H	Eua	3.5	3	4	*Asarum europaeum*	.	.	.	+	+	+	.	.	.	.	II	0.15
H	Eua	3	0	3.5	*Epilobium montanum*	+	+	.	.	.	.	.	+	.	.	II	0.15
Th	Eua	4	3	4	*Impatiens noli-tangere*	.	.	.	.	+	+	.	.	.	+	II	0.15
H	Eua	3.5	3	4	*Salvia glutinosa*	.	.	.	.	+	+	.	+	.	.	II	0.15
Ch	E	3	3.5	4	*Euphorbia amygdaloides*	.	.	.	+	.	.	.	+	.	.	I	0.10
H	Eua	35	3	4	*Sanicula europaea*	+	.	.	.	.	.	.	+	.	.	I	0.10
MPh	E	3	3	3	*Tilia cordata*	.	.	.	+	+	.	.	.	.	.	I	0.10
H	Eua	3.5	3	3	*Actaea spicata*	.	.	.	.	.	.	.	.	+	.	I	0.05
Th	Eua	3	3	4	*Alliaria petiolata*	.	.	.	.	.	.	.	+	.	.	I	0.05
nPh	Eua	3.5	3	0	*Daphne mezereum*	.	.	.	.	.	.	.	+	.	.	I	0.05
H	Eua	3	3	3	*Lathyrus vernus*	.	.	.	+	.	.	.	.	.	.	I	0.05
H	Eua	3.5	3	3	*Myosotis sylvatica*	.	.	.	.	.	.	+	.	.	.	I	0.05
nPh	E	2	3	3	*Rosa canina*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	Eua	3.5	3	0	*Scrophularia nodosa*	+	.	.	.	.	.	.	.	.	.	I	0.05
H	Ec	3	3	3	*Symphytum tuberosum*	.	.	.	+	.	.	.	.	.	.	I	0.05
H	Eua	3.5	0	0	*Stachys sylvatica*	.	.	.	.	.	+	.	.	.	.	I	0.05

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
					Querco-Fagetea												
H	Cosm	4	2.5	0	*Athyrium filix-femina*	+	.	+	+	+	+	+	+	.	+	IV	0.40
H	Ec	3	2.5	0	*Prenanthes purpurea*	+	+	+	+	.	+	+	+	.	+	IV	0.40
G	Eua	3.5	3	4	*Circaea lutetiana*	+	+	.	+	+	.	.	+	.	.	III	0.30
G	Ec	3	3	4	*Dentaria bulbifera*	.	.	.	.	+	+	.	+	+	+	III	0.30
H	E	3	3	0	*Mycelis muralis*	+	+	.	.	+	+	.	+	+	.	III	0.30
MPh	E	3	3	3	*Acer platanoides*	.	+	+	+	+	.	.	+	.	.	III	0.25
mPh	E	3	3	3	*Corylus avellana*	.	.	.	+	1	1	.	+	.	.	II	1.10
G	Carp-B	4	2	3	*Festuca drymeja*	.	.	.	1	+	.	.	+	1	.	II	1.10
H	Eua	3	3	0	*Campanula persicifolia*	.	.	.	+	+	+	.	+	.	.	II	0.20
G	Ec	2.5	3	3	*Galium schultesii*	.	.	.	+	+	+	.	+	.	.	II	0.20
H	Eua	4	3	0	*Dryopteris filix-mas*	+	.	.	+	.	+	.	.	.	.	II	0.15
Th	Eua	2.5	3	3	*Lapsana communis*	.	.	.	.	.	+	.	+	+	.	II	0.15
G	Eua	3	3	3	*Lathraea squamaria*	.	.	+	.	.	.	+	+	.	.	II	0.15
H	Eua	3	3	0	*Poa nemoralis*	+	.	.	+	+	.	.	.	.	.	II	0.15
mPh	E	3	3	3	*Cerasus avium*	+	.	.	+	.	+	.	.	.	.	II	0.15
H	Atl-M	3	3	3	*Atropa belladonna*	+	.	.	.	.	+	.	.	.	.	I	0.10
H	E	3	3	3	*Carex digitata*	.	.	.	.	+	.	.	.	+	.	I	0.10
MPh	E	3	3	4	*Fraxinus excelsior*	.	.	.	.	.	+	+	.	.	.	I	0.10
H	Eua	3	0	3	*Hieracium murorum*	.	.	.	+	.	.	.	+	.	.	I	0.10
H	Cp	2.5	3	2.5	*Hieracium umbellatum*	.	.	+	.	.	+	.	.	.	.	I	0.10
G	Eua	35	0	0	*Petasites albus*	.	.	.	.	+	+	.	.	.	.	I	0.10
Th	Cosm	3.5	3	3	*Geranium robertianum*	.	.	.	.	.	+	.	+	.	.	I	0.10
H	P-M	2.5	3	4	*Glechoma hirsuta*	.	.	.	+	.	.	.	+	.	.	I	0.10
G	E	3	2.5	2.5	*Polygonatum verticillatum*	.	.	.	.	.	.	+	.	+	.	I	0.10
Th	Eua	2.5	3	3	*Moehringia trinervia*	+	+	.	.	.	.	.	.	.	.	I	0.10
G	Cp	3.5	3	0	*Anemone nemorosa*	+	.	.	.	.	.	.	.	.	.	I	0.05
H	Eua	3	3	4	*Astragalus glycyphyllos*	.	.	.	.	+	.	.	.	.	.	I	0.05
H	Eua	3	3	4	*Brachypodium sylvaticum*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	Ec	3.5	3	2	*Carex brizoides*	.	.	.	.	.	.	+	.	.	.	I	0.05
G	E	2.5	3	4	*Cephalanthera longifolia*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	Ec	2.5	3	3	*Dactylis polygama*	.	.	.	.	.	+	.	.	.	.	I	0.05
H	Eua	3	3	4	*Geum urbanum*	.	.	.	.	.	.	.	.	+	.	I	0.05
nPh	Atl-M	3	3	3	*Hedera helix*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	E	3.5	3.5	3.5	*Polystichum aculeatum*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	Ec	4	3	4	*Lunaria rediviva*	.	.	.	.	.	+	.	.	.	.	I	0.05
MPh	Carp	2.5	2.5	0	*Quercus polycarpa*	.	.	.	.	+	.	.	.	.	.	I	0.05
mPh	Eua	3	3	3	*Salix capraea*	.	.	.	.	.	+	.	.	.	.	I	0.05
H	E	3.5	3	3	*Stellaria nemorum*	.	+	.	.	.	.	.	.	.	.	I	0.05
					Epilobietea angustifolii												
nPh	Cp	3	3	3	*Rubus idaeus*	+	+	+	.	.	.	.	.	.	+	II	0.20
MPh	E	3	3	3	*Sambucus nigra*	.	.	.	+	+	+	.	+	.	.	II	0.20
H	Eua	3	2.5	0	*Fragaria vesca*	.	+	.	.	.	.	.	.	.	.	I	0.05
H	Eua	3	2	0	*Galeopsis speciosa*	.	.	.	.	.	+	.	.	.	.	I	0.05
Th	Eua	3	3	0	*Galeopsis tetrahit*	.	.	.	.	+	.	.	.	.	.	I	0.05
					Vaccinio-Piceetea												
TH	Carp-B	3.5	2	2	*Campanula abietina*	.	+	+	.	.	.	.	.	+	+	II	0.20
H	Ec	3.5	2.5	2	*Luzula sylvatica*	.	+	+	.	.	.	+	.	.	.	II	0.15
MPh	E	0	0	0	*Picea abies*	.	.	.	.	.	.	+	.	+	+	II	0.15

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ch	Cp	0	2	1	*Vaccinum myrtillus*	.	.	.	.	.	.	4	.	.	.	I	6.25
H	E	3.5	2.5	2.5	*Homogyne alpina*	.	.	.	.	.	.	+	.	.	.	I	0.05
MPh	Ec	4	3	2	*Abies alba*	.	.	.	.	.	.	.	.	.	+	I	0.05
					Varyae sintaxa												
G	Eua	4	2.5	4	*Veratrum album*	.	+	+	.	.	.	+	.	.	+	II	0.20
H	Cp	0	0	0	*Agrostis capillaris*	.	1	.	.	.	.	.	.	.	.	I	0.50
H	Eua	3	0	3	*Galium mollugo*	1	.	.	.	.	.	.	.	.	.	I	0.50
H	Ec	3.5	2	3	*Doronicum austriacum*	.	.	+	.	+	+	.	.	.	.	I	0.15
H	Eua	4	3	0	*Molinia caerulea*	.	.	+	.	.	.	+	.	.	.	I	0.10
mPh	Carp-B	4	2	3	*Salix silesiaca*	.	+	.	.	.	.	+	.	.	.	I	0.10
H	Eua	4	3	0	*Succisa pratensis*	.	.	.	.	+	+	.	.	.	.	I	0.10
H	Eua	2.5	3	4	*Campanula glomerata*	.	.	.	.	.	+	.	.	.	.	I	0.05
H	Eua	5	0	0	*Cardamine amara*	.	.	.	.	.	.	+	.	.	.	I	0.05
TH	Eua	3	3	0	*Cirsium vulgare*	.	.	.	.	.	.	.	+	.	.	I	0.05
H	E	4.5	0	4.5	*Crepis paludosa*	.	.	.	.	.	.	+	.	.	.	I	0.05
H	Cosm	4	0	0	*Deschampsia caespitosa*	.	.	+	.	.	.	.	.	.	.	I	0.05
H	Carp-B	1	1.5	0	*Doronicum carpaticum*	.	.	.	.	.	.	.	.	.	+	I	0.05
Ch	E	2.5	3	3	*Genista ovata*	.	.	.	+	.	.	.	.	.	.	I	0.05
H	Alp-Carp	3.5	2	0	*Rumex alpinus*	.	.	.	.	.	.	+	.	.	.	I	0.05
H	Cp	2.5	3	3	*Solidago virgaurea*	.	.	.	.	.	.	.	.	+	.	I	0.05

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual therophytes; TH – Biennial therophytes.
F.e. - floristic elements: Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; Cosm - Cosmopolitan; Atl-M - Atlantic-Mediterranean; Carp – Carpathian; Alp-Carp – Alpino- Carpathian; Carp-B – Carpatho-Balkan; P-Med – Ponto-Mediterranean. Ecological indices: U - humidity, T - temperature, Sr - the chemical reaction of the soil. Synthetic phytocoenologic indices: K – constance; ADm - average abundance-dominance.
Place and date of mapping: 1 – Bunei (Sibişelului Valley), 01.08.2010; 2 – Feţele Albe (Grădiştei Valley), 19.07.2011; 3. – Muncel (Grădiştei Valley), 19.07.2011; 4 – Lunca Mare (Grădiştei Valley), 22.07.2011; 5 – Pârâul Crişan (Grădiştei Valley), 22.07.2011; 6 – Tihu (Grădiştei Valley), 22.07.2011; 7. Anineşu (Aninesului Valley), 22.07.2011; 8. Izvorele (Aninesului Valley), 22.07.2011; 9. Prislop (Sibişelului Valley), 21.07.2011; 10. Meleia (Grădiştei Valley), 03.08.2010.

soils. This conclusion is also advocated by the presence of highly acidophylous species (*Deschampsia flexuosa*, *Blechnum spicant*, *Vaccinum myrtillus*) and acid-neutrophylous (*Acer pseudoplatanus*, *Pulmonaria rubra*, *Galium odoratum*, *Rubus hirtus* subsp. *hirtus*, *Tilia cordata*, *Actaea spicata*, *Myosotis sylvatica*, *Symphytum tuberosum*, *Festuca drymeja*, *Galium schultesii*, *Dactylis polygama*, *Stellaria nemorum*), growing on highly acid soils to medium and slightly acid soils.

The characteristic species for the reference association, *Fagus sylvatica* subsp. *sylvatica*, visible in the upper highlands (1100-1370 m) of the Orăştie river basin (Şureanu Mountains), is a „climatic ecotype well adapted to a shorter vegetation cycle with large thermal variations" [33]. In stations at the base of the slopes, at altitudes of 760-830 m, there occur sporadically the ligneous species *Carpinus betulus*, adapted to a continental type of climate, and *Tilia cordata*, which prefer the moderately thermal regimes [33].

The acidophylous beech forests (Feţele Albe, Muncel, Lunca Mare, Pârâul Crişan, Tihu, Anineşu, Izvorele, Meleia) in the Orăştie river basin (Şureanu Mountains) are located within the limits of the Grădiştea Muncelului-Cioclovina Natural Park (Site Natura 2000), inside some of these forests being located the actual sites of Dacian settlements and fortresses [39, 40]. Men should not interfere with these highly natural secular forests, where felled decaying wood trunks abund on the ground (Fig. 2), thus letting the nature follow its own course.

From an ecological point of view, the beech forests represent the actual main sustain in preserving the Carpathians' ecological balance [21]. The acidophylous beech forests in the Orăştie river basin (Şureanu Mountains) we analysed in this paper are located on slopes with medium (18-22º) and high (41-46º) drop and have a major role in protecting the landscape and the soil against erosion. Popescu *et. al* (2004), points out: ″besides their economical and anti-erosional relevance, the beech forests have acknowledged protection functions, being able of balancing the hydrological regime more than any other forest formation, ensuring high quality drinking water and filtering high quantities of the dust in the atmosphere″ [21].

Generally all forests have a variety of values, from environmental to social, cultural, etc. [12]. When these values raise to exceptional, the forest may be considered as having a ″high preservation value″ [12]. The acidophylous beech forests in the Orăştie river basin (Şureanu Mountains) are of utmost importance for the environmental protection, the preservation of biodiversity and the cultural values, since these forest areas [41]:

- are highly natural old forests;
- shelter species of plants that are rare, endangered and Tertiary relics;
- control the erosion, the landslides and the avalanches;

preserve Europe's only sites of Dacian settlements and fortresses.

REFERENCES

[1] Borza, A., Boşcaiu, N., (1965): Introducere în studiul covorului vegetal. Academiei Române Publishing House, Bucharest, 342 p.

[2] Braun-Blanquet, J., Pavillard, J., (1928): Vocabulairae de Sociologie Végétale. Troisicme edition. Imprimerie Lemair –Ardres, pp. 15-18.

[3] Braun-Blanquet, J., (1964): Pflanzensoziologie. Springer-Verlag, Wien-New York, 3, Aufl, pp. 12-24.

[4] Ciocârlan, V., (2009): Flora ilustrată a României. Pteridophyta et Spermatophyta. Ceres Publishing House, Bucharest, 1141 p.

[5] Cristea, V., Gafta, D., Pedrotti, F., (2004): Fitosociologie. Presa Universitară Clujeană Publishing House, Cluj-Napoca, 394 p.

[6] Dihoru, Gh., Negrean, G., (2009): Cartea roşie a plantelor vasculare din România. Academiei Române Publishing House, Bucharest, 630 p.

[7] Doniţă, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriş, I.A., (2005): Habitatele din România. Tehnică Silvică Publishing House, Bucharest, pp. 182-183.

[8] Dierschke, H., (1998): Syntaxonomical survey of European beech forests: some general conclusions. Annali di Botanica, Roma, 55: 17-26.

[9] Drăgulescu, C., (1995): Flora şi vegetaţia din bazinul Văii Sadului. Constant Publishing House, Sibiu, pp. 294-296.

[10] Drăgulescu, C., (2010): Cormoflora judeţului Sibiu. University ″Lucian Blaga″ Publishing House, Sibiu, 831 p.

[11] Ellenberg, H., (1974): Zeigerwerte der Gefässpflanzen Mitteleuropas - Scripta Geobotanica. Göttingen, 9: 1-97.

[12] Jennings, S., Nussbaum, R., Judd, N., Evans, T., (2003): The High Conservation Value Forest Toolkit, 1st edition, Part I: Introduction. Pro Forest, Oxford, UK. 21 p.

[13] Morariu, I., Ularu, P., Danciu, M., Lungescu, Elena (1968): Făgetele de pe Măgura Codlei. Buletinul Institutului Politehnic Braşov, Seria B. Economie Forestieră, Braşov, 10: 43-47.

[14] Mucina, L., Grabherr, G., Ellmaner, T., (1993): Die Pflanzengesellschaften Österreich, teil I. Anthropogene Vegetation, (Gustav Fischer) Verlag, Jena-Stuttgart-New- York, 13: 149-169.

[15] Oltean, M., Negrean, G., Popescu, A., Roman N., Dihoru., G., Sanda, V., (1994): Lista Roşie a plantelor superioare din România, Studii, sinteze, documentaţii de Ecologie, I, Bucureşti, pp. 1-52.

[16] Oprea, A., (2005): Lista critică a plantelor vasculare din România, University Al. I. Cuza Publishing House, Iaşi, 398 p.

[17] Pătru, I., Zaharia L., Oprea, R., (2006): Geografia fizică a României, climă, ape, vegetaţie, soluri. Universitară Publishing House, Bucharest, 175 p.

[18] Păşcuţ, C.G., Burescu, P., (2010): Contributions to the phytocenologic study in pure european beech stand forests in Codru-Moma Montains (Nord-Western of Romania). Analele Universităţii Oradea – Fascicula Biologie, University of Oradea Press, 17(1): 158-165.

[19] Pop, I, Hodişan, I., (1981): Analiza vegetaţiei forestiere de pe Valea Someşului Cald (judeţul Cluj). Contribuţii Botanice, Cluj-Napoca, pp. 41-58.

[20] Pop, I., Cristea, V., Hodişan, I., (2002): Vegetaţia judeţului Cluj. Studiu fitocenologic, ecologic,

bioeconomic şi ecoprotectiv. Contribuţii botanice, 1999-2000, Cluj-Napoca, 35(2): 5-254.
[21] Popescu, G., Pătrăşcoiu, N., Georgescu, V., (2004): Pădurea şi omul. Nord Carta Publishing House, Suceava, 602 p.
[22] Popescu, N., (1977): Munţii Căpăţînii, ghid turistic. Sport-Turism Publishing House, Bucharest, pp. 5-14.
[23] Pott, R., (1995): Die Pflanzengesellschaften Deutschlands. 2 Auflage, Verlag Eugen Ulmer, Stuttgard, 622 p.
[24] Răduţoiu, D., (2006): Flora şi vegetaţia bazinului Cernei de Olteţ. Dihoru, Gh., PhD Thesis Coordinator, Bucharest, 278 p.
[25] Răduţoiu, D., (2008): Flora şi vegetaţia bazinului Cernei de Olteţ. Sitech Publishing House, Craiova, 407 p.
[26] Rodwell, J.S., Schaminée, J.H.J., Mucina, L., Pignatti, S., Dring, J., Moss, D., (2002): The diversity of European vegetation - An overview of phytosociological alliances and their relationships to EUNIS habitats. National Centre for Agriculture, Nature Management and Fisheries, Wageningen, 168 p.
[27] Sanda, V., (2002): Vademecum ceno-structural privind covorul vegetal din România. Vergiliu Publishing House, Bucharest, 331 p.
[28] Sanda, V., Barabaş, N., Biţă-Nicolae, C., (2005): Breviar privind parametrii structurali şi caracteristicile ecologice ale fitocenozelor din România. Partea I. ″Ion Borcea″ Press, Bacău, 255 p.
[29] Sanda, V., Răduţoiu, D., Burescu, P., Blaj-Irimia, I., (2007): Breviar fitocenologic. Partea a IV-a. Sitech Publishing House, Craiova, pp. 93-94.
[30] Sanda, V., Kinga, Ö., Burescu, P., (2008): Fitocenozele din România, sintaxonomie, structură, dinamică şi evoluţie. Ars Docendi Press, Bucharest, 570 p.
[31] Soó, R. (1980): A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve VI. Akadémiai Kiadó, Budapest, 556 p.
[32] Speta, E., Rákosy, L., (2010): Wildpflanzen Siebenbürgens. Verlag und Druch: Plöchl Druck GmbH, Freistadt, Austria, 624 p.
[33] Şofletea, N., Curtu, L., (2007): Dendrologie. Universităţii Transilvania Publishing House, Braşov, pp. 156-163.
[34] Trufaş, V., (1986): Munţii Şureanu, ghid turistic. Sport-Turism Publishing House, Bucharest, pp. 7-46.
[35] Tüxen, R., (1955): Das System der nordwestdeutschen Pflanzengesellschaften, Mitt Floristic-Sociologie Arbeitsgen, n. Folge, 5: 155-176.
[36] Vinţan, V., (2011): Caracterizarea hidrografică a bazinului râului Orăştie. GEIS, Referate şi comunicări de geografie, Casa Corpului Didactic Publishing House, Deva, 15: 70-73.
[37] Weber, H. E., Moravec, J., Theurillat, J.-P., (2000): International Code of Phytosociological Nomenclature. 3rd edition, Journal of vegetation Science 11: 739–768. Opulus Press, Uppsala, Sweden.
[38] *** (2011): Harta municipiului Orăştie. Schubert& Franzke, Cluj-Napoca.
[39] *** http://www.cnr-unesco.ro/docs/rap6.pdf: Raport de monitorizare a cetăţilor dacice din Munţii Orăştiei, accessed in 4 March 2012.
[40] *** http://www.gradiste.ro, accessed in 5 January 2012.
[41] *** http://www.certificareforestiera.ro/pag/pvrc_categorii.htm, accessed in 6 April 2012.

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