

CONTRIBUTIONS TO THE PHYTOCOENOLOGICAL STUDY OF THE ASSOCIATION *PULMONARIO RUBRAE-FAGETUM* (SOÓ 1964) TÄUBER 1987 IN THE ORĂȘTIE 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 *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, identified in the Orăștie 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 relevés performed in the mixed broadleaf-needleleaf forests of beech (*Fagus sylvatica* subsp. *sylvatica*), fir (*Abies alba*) and spruce (*Picea abies*) with *Pulmonaria rubra* belonging to the Orăștie river basin.

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

Keywords: *Pulmonaria rubra*; phytocoenoses; association; relevés; life forms; ecological indices; Orăștie river basin.

INTRODUCTION

The hydrographic basin of the Orăștie 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 Orăștie river discharges into the Mureș river [13, 32, 34].



Figure 1. Position of Orăștie River Basin in Romania [36]

The Șureanu 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. Within the studied territory only a fraction of the Șureanu Mountains is included, namely the west-north-western corner commonly known as the Orăștie Mountains or the Sarmizegetusa Mountains or the Mountains of the

Dacian Fortresses [32]. The highlands of the Orăștie river basin, where the phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (Syn.: *Pulmonario rubrae-Abieti-Fagetum* Soó 1964; *Abieti-Fagetum* sensu auct., *Abietetum dacicum* Beldie 1951) have been identified, lie between the altitudes of 940 m and 1150 m.

The Șureanu Mountains consist mainly of meso-metamorphic and epi-metamorphic schists surrounded peripherally by some areas of sedimentary rocks (sandstones, conglomerates, limestones etc.) [32].

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 Orăștie lowlands and Parâng highlands [32].

The thermal differences between the outskirts of the mountains and the high ridges are of roughly 10°C on average. Towards their north-western limits, due to warm air incursions from the Western Plains, the average temperatures range from 9 to 10°C [32]. In winter, the average temperatures vary between minus 2 and minus 7°C, in spring they rise by 6 to 12°C, in summer they reach 8°C on the mountain tops and over 19°C on the outskirts, while in autumn the average temperatures decrease by 5.5 to 7°C as compared to those in the summer months [7, 32].

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 [32]. In the whole of Transylvania the rainfall quantum is 500 to 700 mm per year [18].

The association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, is widespread in the Romanian Carpathians, it being previously described in the Eastern, Southern and Western Carpathians [5, 8, 11, 14, 19, 23, 28].

The phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (Fig. 2) has a small occurrence in upper part of the Orăștie river basin. In the territory under scrutiny we found other forest associations as well: *Carpino-Fagetum* Paucă

1941, *Symphyto cordati-Fagetum* Vida 1963, *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, *Festuco drymejae-Fagetum* Morariu et al. 1968.



Figure 2. Association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (in Orăștie River Basin)

MATERIALS AND METHODS

The vegetation studies of the catchment basin of the Orăștie river (central-western Romania) were carried out between the years of 2011 and 2012 targeting all types of sites indicative of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964) [4], 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 Boșcaiu (1965) [1]. The associations were identified using the characteristic species, without neglecting the differential and dominant species [1, 6, 9].

In order to thoroughly identify the phytocenoses of the association, we performed a total of 9 phytocoenologic relevés, of which 5 relevés were included in the synthetic table of the association (Table 1), the other 4 having been excluded from the table since they displayed similar stational conditions. In order to perform the sampling relevés, 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, 6].

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 relevé, 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) [3], and we filled in the overall vegetation coverage using the method designed by Tüxen (1955) [33] and Ellenberg (1974) [12].

The phytocoenologic table of the association was structured according to the methodology designed by Braun-Blanquet (1964) [4] and improved by Ellenberg (1974) [12]. In order to rank the association among the

coeno-taxonomic units, namely suballiance, alliance, order, class, we took into account both the traditional ecological-floristic systems developed by Tüxen (1955) [33], Braun-Blanquet (1964) [4], Borza et Boșcaiu (1965) [1], Soó (1980) [29], as well as the more recent papers by researchers such as Mucina et al. (1993) [16], Pott (1995) [21], Borhidi (1996) [2], Weber et al. (2000) [35], Sanda (2002) [25], Sanda et al. (2008) [27]. In order to frame the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (analysed by us in this paper) into the superior coeno-taxonomic units we referred to Sanda et al. (2008) [27].

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 phytocenoses. The values of the synthetic phytocoenologic indices, constance (K) were calculated using the methods proposed by Braun-Blanquet et Pavillard (1928) [3], Cristea et al. (2004) [9].

The nomenclature of taxa was done according to Ciocârlan (2009) [6], and the plant 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 [6, 26].

RESULTS

The phytocenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, were identified in the following places: Godeanu, Culmea Lupșei – Pârâul Afinișului, Culmea Lupșei – Pasul Scurt, Lupșa – Pârâul Urșilor.

They were found on slopes with discrete exposition (S, SE, N, NE, NW), with a slope of 25-40°, at altitudes of 940-1150 m (Table 1), covering eutricambosols weakly-textured, medium to weakly acid, developed on crystalline schists as a rule [37, 38].

The physiognomy and the floristic composition. These are natural quasi-pristine forests, with trees of 100-160 years old with many wood trunks felled by hazards (4-8%) and decayed (Fig. 2). The floristic inventory of the *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 association comprises a total of 71 species. Out of the total number of species, 54 of all (76.05%) belong to the coenotaxa subordinating the association, and 17 species (23.95%) are transgressive from and adjacent to other associations.

The dominant forest species *Fagus sylvatica* subsp. *sylvatica*, *Picea abies*, *Abies alba*, are accompanied sporadically by: *Acer pseudoplatanus*, *Ulmus glabra*, *Sorbus aucuparia*. The canopy coverage is around 75%-90%. The trunk diameters vary between 40 and 54 cm, while they rise up to 25-32 m in height [37, 38].

The shrubby species, unevenly dispersed in the wooded area, consist of the following: *Daphne mezereum*, *Corylus avellana*, *Lonicera xylostereum*, *Rubus idaeus*, *Rubus hirtus*, *Sambucus racemosa*.

The herbaceous layer, with a coverage of 15% to 35%, has *Pulmonaria rubra* as characteristic species

and the one that defines the association. The remainder of this synusium's spectrum of species belongs to the suballiance *Symphyto-Fagenion* Boșcaiu *et al.* 1982 (*Symphytum cordatum*, *Festuca drymeja*, *Hieracium transsylvanicum*, *Silene heuffelii*), the alliance *Symphyto cordati-Fagion* Vida 1959 (*Festuca altissima*, *Dentaria glandulosa*, *Euphorbia carniolica*, *Gentiana asclepiadea*, *Leucanthemum waldsteinii*), the order *Fagetalia sylvaticae* (*Luzula luzuloides* subsp. *luzuloides*, *Oxalis acetosella*, *Galium odoratum*, *Circaea lutetiana*, *Geranium robertianum*, *Mercurialis perennis*, *Ajuga reptans*, *Salvia glutinosa*, *Dentaria bulbifera*, *Epilobium montanum*, *Euphorbia amygdaloides*, *Galeobdolon luteum*, *Galeopsis speciosa*, *Isopyrum thalictroides*, *Lilium martagon*, *Paris quadrifolia*, *Phegopteris concectilis*, *Sanicula europaea*) and to the class *Quercu-Fagetea* Br.-Bl. et Vlieger in Vlieger em. Borhidi 1996, among them worth mentioning are the species displaying a greater value of the constancy (K): *Athyrium filix-femina*, *Impatiens noli-tangere*, *Geum urbanum*, *Dryopteris filix-mas*, *Glechoma hirsuta*.

The life forms spectrum of the association under consideration (Fig. 3) highlights the numerical prevalence of hemicryptophytes (H = 53.52%). The hemicryptophytes are closely followed by geophytes (G = 19.71%), phanerophytes (Ph = 18.29% of which: MPh = 9.85%, mPh = 4.22%, nPh = 4.22%), therophytes (Th + TH = 7.03%) with a poor percentage. The chamaephytes (Ch = 1.40%), 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 = 29.57%), followed by those European (E = 26.76%), then the Circumpolar elements (Cp = 14.08%), and those Central European (Ec = 11.26%). It is also worth mentioning the presence in the territory under consideration of the Balkan-Carpathian elements (Carp-B = 4.22%) and the Cosmopolitan elements (Cosm = 4.22%).

The analysis of the diagram of ecological indices (Fig. 5) reveals a great majority of mesophilous species ($U_{3-3.5} = 76.04\%$), followed by meso-hygrophilous ($U_{4-4.5} = 14.14\%$), and xero-mesophilous species ($U_{2-2.5} = 7.03\%$). One can notice the dominance of micro-mesothermophil species ($T_{3-3.5} = 53.51\%$), followed by microthermophil ($T_{2-2.5} = 29.56\%$), and eurytherm ($T_0 = 15.49\%$). The diagram of ecological indices reveals the prevalence of the acid-neutrophilous (medium acidophilous) species ($R_3 = 36.61\%$), followed by the weakly acid-neutrophilous species ($R_4 = 29.57\%$), acidophilous ($R_2 = 7.03\%$), and euri-ionic ($R_0 = 25.35\%$).

DISCUSSIONS

The phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (Syn.: *Pulmonario rubrae-Abieti-Fagetum* Soó 1964; *Abieti-Fagetum* sensu auct., *Abietetum dacicum* Beldie 1951),

covering limited areas in the Orăștie river basin – Șureanu Mountains, have not been researched as yet.

The phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, analysed from the viewpoint of the life forms spectrum (Fig. 3), are dominated by the presence of hemicryptophytes, their abundance being largely influenced by the mild temperate climate, the natural hazards (wind and snow felled trees), followed by geophytes, which illustrate the presence of a habitat where these species round up their short vegetation cycle in early spring and spring, and by phanerophytes as the basic constituents of forests. The terophytes, with a poor percentage, illustrate a low anthropic impact on flora and vegetation in the studied territory.

The floristic elements spectrum for this association (Fig. 4), reveals the dominance of the Eurasian species, with their genetic centre in the continents of Europe and Asia, followed by those European, with their genetic centre in the regions with a mild temperate climate of Europe. The Circumpolar elements, and those Alpino-Carpathian-European are present in a moderate percentage, extant only in the forest stands with climatic conditions similar to those of the Boreal

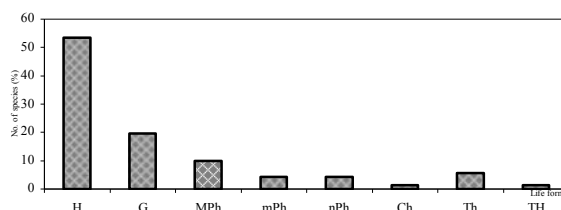


Figure 3. Life forms spectrum of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch- Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual therophytes; TH - Biannual therophytes.

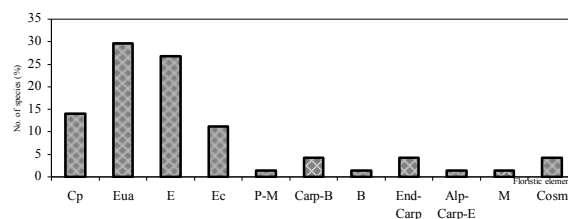


Figure 4. Spectrum of floristic elements for the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, where: Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; P-M - Pontic-Mediterranean; Carp-B - Balkan-Carpathian; B - Balkan; End-Carp - Carpathian endemism; Alp-Carp-E - Alpino-Carpathian-European; M - Mediterranean; Cosm - Cosmopolitan.

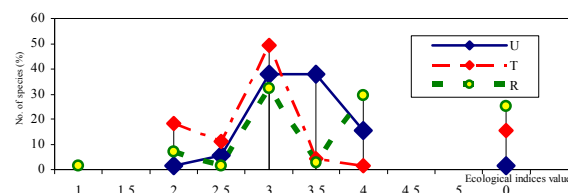


Figure 5. The diagram of ecological indices for the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, where: U - soil moisture, T - temperature, R - the chemical reaction of the soil.

Table 1. Association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (Syn.: *Pulmonario rubrae-Abieti-Fagetum* Soó 1964; *Abieti-Fagetum* sensu auct., *Abietetum dacicum* Beldie 1951) in Oraștie River Basin

L.f.	F.e.	U.	T.	R.	No. of relevé	1	2	3	4	5	K
					Altitude (a.s.l.)	940	960	1150	1050	1100	
					Exposition	SE	NV	S	N	NE	
					Slope (degree) (°)	40	30	25	35	35	
					Hight of the trees (m)	28	25	31	29	32	
					Trunk diam. (cm)	44	54	40	50	45	
					Consistency of tree layer (%)	90	75	85	80	75	
					Shrubbery layer (%)	7	2	2	2	2	
					Herbaceous layer cover (%)	30	35	15	30	25	
					Surface (m²)	400	400	400	400	400	
0	1	2	3	4	5	6	7	8	9	10	11
					Car. ass.						
MPh(mPh)E		3	3	0	<i>Fagus sylvatica</i> subsp. <i>sylvatica</i>	5	4	4	3	4	V
H	Carp-B	3.5	2	3	<i>Pulmonaria rubra</i>	+	1	+	+	+	V
					Symphyto-Fagenion						
H-G	End-Carp	3	2	3	<i>Symphytum cordatum</i>	+	1	+	+	+	V
G-H	E-M	4	2	3	<i>Festuca drymeja</i>	+	+	.	1	+	IV
H	Carp-B	3	0	0	<i>Hieracium transsylvanicum</i>	.	.	+	+	.	II
TH(H)	Carp-B	3.5	2	0	<i>Silene heuffelii</i>	.	.	+	.	.	I
					Symphyto cordati-Fagion						
MPh	E	4	3	0	<i>Abies alba</i>	+	1	1	1	1	V
MPh	Ec	3.5	3	3	<i>Acer pseudoplatanus</i>	.	+	+	.	+	III
H	E	3.5	3	4	<i>Festuca altissima</i>	+	+	.	+	.	III
G	End-Carp	4	2.5	4	<i>Dentaria glandulosa</i>	+	.	.	.	+	II
H	Alp-Carp-E3	4	4	4	<i>Euphorbia carniolica</i>	.	.	.	.	+	I
H	Ec(Mont)	4	2	4	<i>Gentiana asclepiadea</i>	.	.	.	+	.	I
H	End-Carp	4	2	3	<i>Leucanthemum waldsteinii</i>	.	.	.	+	.	I
					Fagetalia sylvaticae						
H	E	2.5	2.5	2	<i>Luzula luzuloides</i>	1	+	1	+	+	V
					subsp. <i>luzuloides</i>						
H-G	Cp	4	3	3	<i>Oxalis acetosella</i>	+	+	+	1	1	V
G	Eua	3	3	3	<i>Galium odoratum</i>	+	1	+	+	.	IV
G	Eua(M)	3.5	3	4	<i>Circaea lutetiana</i>	+	+	.	.	+	III
Th-TH	Cosm	3.5	3	3	<i>Geranium robertianum</i>	+	+	.	+	.	III
G(H)	E	3.5	3	4	<i>Mercurialis perennis</i>	+	+	.	.	+	III
H	E	3.5	0	0	<i>Ajuga reptans</i>	+	+	.	.	.	II
H	Eua(Mont)	3.5	3	4	<i>Salvia glutinosa</i>	+	.	+	.	.	II
H(Hh)	Cp	3.5	3	4	<i>Carex sylvatica</i>	.	.	+	+	.	II
nPh	Eua	3.5	3	3	<i>Daphne mezereum</i>	.	.	.	+	+	II
G-H	Ec	3	3	4	<i>Dentaria bulbifera</i>	+	+	.	.	.	II
H	Eua	3	0	3.5	<i>Epilobium montanum</i>	+	.	.	.	+	II
Ch	E(M)	3	3.5	4	<i>Euphorbia amygdaloides</i>	.	+	+	.	.	II
H-Ch	Ec	3	0	4	<i>Galeobdolon luteum</i>	+	.	.	+	.	II
Th	Eua	3	2	0	<i>Galeopsis speciosa</i>	.	+	.	+	.	II
G	Ec	3	3.5	3	<i>Isopyrum thalictroides</i>	+	+	.	.	.	II
G	Eua	3	0	4	<i>Lilium martagon</i>	.	+	.	+	.	II
H	Eua	3.5	0	4	<i>Paris quadrifolia</i>	+	.	+	.	.	II
H	Cp	3.5	2	2	<i>Phegopteris connectilis</i>	.	+	.	.	+	II
H	Eua	3.5	3	4	<i>Sanicula europaea</i>	.	.	+	.	+	II
H	Eua	3.5	0	0	<i>Stachys sylvatica</i>	.	+	.	.	+	II
G	Ec-M	3.5	3	4	<i>Galanthus nivalis</i>	.	(+)	.	.	.	I
G	Cp	3	2.5	2	<i>Gymnocarpium dryopteris</i>	.	.	.	+	.	I
H	E	3.5	3	3	<i>Pulmonaria officinalis</i>	+	.	.	.	.	I
H	Ec(M)	3.5	2	3	<i>Senecio ovatus</i>	.	+	.	.	.	I
					Quercu-Fagetea						
H	Cosm	4	2.5	0	<i>Athyrium filix-femina</i>	1	+	+	1	+	V
Th	Eua	4	3	4	<i>Impatiens noli-tangere</i>	+	+	.	+	+	IV
H	M(Cp)	3	3	4	<i>Geum urbanum</i>	+	+	+	.	+	IV
nPh	Eua	3	2.5	3	<i>Rubus hirtus</i>	1	+	.	+	+	IV
H	Cosm	4	3	0	<i>Dryopteris filix-mas</i>	+	.	+	.	1	III
H-Ch	P-M	2.5	3	4	<i>Glechoma hirsuta</i>	+	+	+	.	.	III
G	Cp	3.5	3	0	<i>Anemone nemorosa</i>	+	+	.	.	.	II
H	Cp	3	3	4	<i>Hepatica nobilis</i>	+	+	.	.	.	II
G	Eua	3	3	3	<i>Lathraea squamaria</i>	.	.	+	+	.	II
H	E	3	3	0	<i>Mycelis muralis</i>	+	+	.	.	.	II
H	Ec(Mont)	3	2.5	0	<i>Prenanthes purpurea</i>	.	.	.	+	+	II
mPh	B	3	3	3	<i>Corylus avellana</i>	+	+	.	.	.	II
mPh	Eua	3	3	4	<i>Lonicera xylosteum</i>	.	+	+	.	.	I
Th(TH)	Eua(M)	2.5	3	3	<i>Moehringia trinervia</i>	+	.	.	.	.	I

0	1	2	3	4	5	6	7	8	9	10	11
H	Cp	3	3	0	<i>Poa nemoralis</i>	.	+	.	.	.	I
H	Eua	3.5	3	0	<i>Scrophularia nodosa</i>	.	.	.	+	.	I
Moehringio muscosae-Acerenion											
H	E	3.5	3.5	3.5	<i>Polystichum aculeatum</i>	+	1	+	+	.	IV
MPh-mPh	Eua	4	3	3	<i>Ulmus glabra</i>	+	+	.	.	+	III
H	Eua	3	0	3	<i>Campanula latifolia</i>	.	+	.	.	+	II
H	E	4	3	4	<i>Lunaria rediviva</i>	.	.	.	+	.	I
Vaccinio-Piceetea											
MPh	E	0	0	0	<i>Picea abies</i>	+	1	2	3	1	V
H	Eua(C)	2.5	3	2	<i>Calamagrostis arundinacea</i>	1	+	.	1	1	IV
MPh-mPh	E	3	2.5	2	<i>Sorbus aucuparia</i>	+	+	.	.	+	III
H	Cp	2	0	1	<i>Deschampsia flexuosa</i>	.	.	+	.	.	I
H	E(Alp)	3.5	2.5	2.5	<i>Homogyne alpina</i>	.	+	.	.	.	I
Variae syntaxa											
G	E(Mont)	3.5	2	3	<i>Doronicum austriacum</i>	+	.	+	.	+	III
G	Eua	3.5	0	0	<i>Petasites albus</i>	+	+	.	.	.	II
nPh	Cp	3	3	3	<i>Rubus idaeus</i>	+	.	.	1	.	II
MPh-mPh	E(M)	3	3	3	<i>Sambucus nigra</i>	+	.	+	.	.	II
mPh	Cp	3	2	3	<i>Sambucus racemosa</i>	.	.	+	.	+	II
H	E(Alp)	3.5	2	0	<i>Adenostyles alliariae</i>	.	.	.	.	+	I
H	E(Mont)	3.5	2	0	<i>Cicerbita alpina</i>	.	.	.	+	.	I
H	Eua	3.5	3	3	<i>Senecio germanicus</i>	.	+	.	.	.	I

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual therophytes.

F.e. - floristic elements: Alp-Carp-E - Alpine-Carpathian-European; B - Balkan; Carp-B - Carpathian-Balkan; Cosm - Cosmopolitan; Cp - Circumpolar; E - European; E(Alp) - European-Alpine; E-M - European-Mediterranean; E(Mont) - European-mountain; Ec - Central European; Ec-M - Central European-Mediterranean; Ec(Mont) - Central European-Mountain; End-Carp - Carpathian endemism; Eua - Eurasian; Eua(C) - Eurasian continental; Eua(M) - Eurasian-Mediterranean; Eua(Mont) - Eurasian-Mountain; M(Cp) - Mediterranean-Circumpolar; P-M - Pontic-Mediterranean.

Ecological indices: U - soil moisture, T - temperature, R - the chemical reaction of the soil; the values range between 1 and 6 [26]. Synthetic phytocoenological indices: K - constancy.

Place and date of relevés: 1, Godeanu, 19.07.2012; 2, Culmea Lupșei - Pârâul Afinișului, 21.07.2011; 3, Culmea Lupșei - Pasul Scurt, 21.07.2011; 4 - 5, Lupșa - Pârâul Urșilor (22.07.2011).

zone. The Central-European species, with their genetic centre in the regions with a mild and wet temperate climate of Europe, transgressed to the more continental regions, including the Orăștie river basin. The existence of southern elements, Mediterranean and Pontic-Mediterranean, is due to the warm air incursions through the Mureșului Corridor and the Orăștiei Corridor, originating in the Mediterranean Sea. It is also worth mentioning the presence in the territory under consideration of the Balkan-Carpathian elements and Balkan elements, which are characteristic of the Carpathian and Balkan Mountains, and the Carpathian endemisms, not to be found elsewhere in the world.

Upon analysing the diagram of ecological indices (Fig. 5), it goes that the phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 are strongly mesophilous, micro-mesothermophilous to micro-termophilous, and medium acidophilous to weakly acid-neutrophilous.

The floristic inventory of these mixed broadleaf/needleleaf forests consists of endangered species of plants (*Abies alba*) [17], rare ones (*Leucanthemum waldsteini*) [17], Carpathian endemisms (*Dentaria glandulosa*, *Symphytum cordatum*) [6], Tertiary relicts (*Sanicula europaea*) [6].

The ligneous species such as: *Acer platanoides*, *Carpinus betulus*, *Quercus petraea*, occur sporadically, in the phytocoenoses researched by Pop *et al.* (2002), situated at altitudes of 700-1000 m; their absence in the phytocoenoses from the Orăștie river basin was brought about by the higher altitudes here (940-1150 m), wherein the maples, hornbeams and sessile oaks no

longer find optimal growing conditions. To this conclusion amounts other data as well: the phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 in the Pădurea Craiului Mountains analysed by Groza (2008) [14], situated at altitudes of 800-900 m, consist of ligneous species that need more heat in the growing season (*Carpinus betulus*, *Cerasus avium*, *Fraxinus excelsior*), therefore they are absent in the Orăștie river basin [31]; in the Curvature Subcarpathians the phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, described by Chifu *et al.* (2006) [5], consist of warmth loving species (*Acer campestre*, *Carpinus betulus*, *Cerasus avium*, *Fagus orientalis*, *Fagus taurica*, *Fraxinus excelsior*, *Sorbus torminalis*), which do not occur in the Orăștie river basin.

We consider that the mixed forests of beech (*Fagus sylvatica* subsp. *sylvatica*) and needleleaf trees (*Abies alba*, *Picea abies*) in the Orăștie river basin - Șureanu Mountains are, phytocoenologically speaking, more like those from the Rodnei Mountains, researched by Coldea (1990) [8]. The floristic inventory of the phytocoenoses of *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 association in the two regions is very similar. Thus, in the tree layer, apart from the species that are dominant, *Fagus sylvatica* subsp. *sylvatica*, *Abies alba* and *Picea abies*, here and there *Ulmus glabra* and *Acer pseudoplatanus* occur. In the herbaceous layer, apart from the dominant and characteristic species of the association, *Pulmonaria rubra*, the following species also make a remarkable display: *Symphytum cordatum*, *Festuca drymeja*,

Luzula luzuloides subsp. *luzuloides*, *Oxalis acetosella*, *Galium odoratum*, *Mercurialis perennis*. The microthermophil species such as: *Aconitum moldavicum*, *Ranunculus carpathicus*, *Ribes alpinus*, listed as rare, or endangered in România [17, 30], only occur in the Rodnei Mountains, due to the higher ground here, no doubt (870-1220 m).

The wooded areas of beech (*Fagus sylvatica* subsp. *sylvatica*), fir (*Abies alba*) and spruce (*Picea abies*) with *Pulmonaria rubra* (COD NATURA 2000: 91 VO Dacian beech forests – *Shymphyto-Fagion*; COD EUNIS: G4.6 Mixed – *Abies-Picea-Fagus-woodlands*), cover surfaces of about 520.000 hectares in the entire Romanian Carpathians, with a medium conservation value [10, 24].

The phytocoenoses of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987, having a high naturalness degree (relevés 1 – Godeanu), are part of the Grădiștea Muncelului-Cioclovina Natural Reserve (Site Natura 2000) [39].

We consider that the mixed broadleaf/needleleaf forests in the Oraștie river basin have a "high conservation value", them being important from the environmental protection, as well as the conservation of biodiversity viewpoints [15, 22].

In keeping with the principles stated above, these forests are of an important conservation value because:

- they shelter endangered species (*Abies alba*), rare species (*Leucanthemum waldsteinii*), Carpathian endemisms (*Dentaria glandulosa*, *Symphytum cordatum*), Tertiary relicts (*Sanicula europaea*);
- they preserve the quantity and the quality of water;
- they provide wood and other produce for local communities;
- since they cover mainly slopes of 25-40°, the forest management must permanently keep a reasonably high coverage percentage so that their role of soil protection against erosion, landslides or avalanches be enforced [20].

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