CONTRIBUTIONS TO THE PHYTOCOENOLOGICAL STUDY OF PURE EUROPEAN BEECH FORESTS IN ORAŞTIE RIVER BASIN (CENTRAL-WESTERN ROMANIA)

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Abstract. În the current paper we present a phytocoenologic study of the phytocoenoses of the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968 (Syn.: *Fagetum sylvaticae transylvaticum* facies with *Festuca drymeja* I. Pop *et al.* 1974), found in the pure European beech forests of the Orăştie river basin, lying 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 of pure European beech forests belonging to the Orăştie river basin.

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, Sarmizegetusa.

INTRODUCTION

The hydrographic basin of the Orăştie river lies in the central-western part of Romania (Fig. 1). It is located in 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 [29, 31].

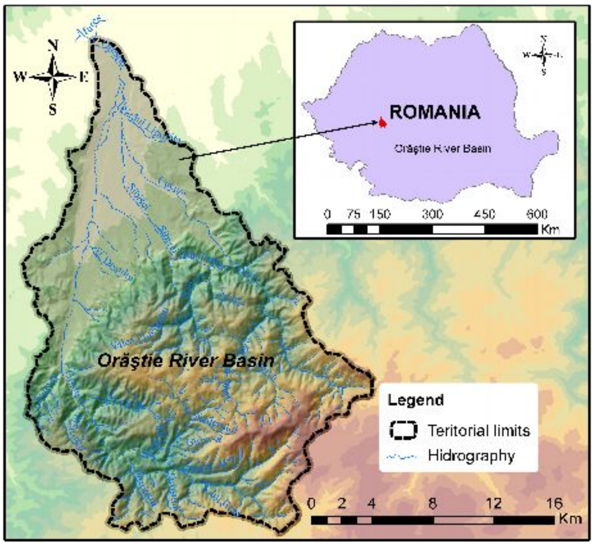

Figure 1. Position of Orăştie River Basin in Romania [32] (modified)

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 Oraştie Mountains or the Sarmizegetusa Mountains or the Mountains of the Dacian Fortresses [29]. The highlands of the Orăştie river basin, where the phytocoenoses of the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968 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.) [29].

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 [29].

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 Banato-Crişana plains, the average temperatures range from 9 to 10ºC [29]. 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 [29].

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

The association *Festuco drymeiae-Fagetum* Morariu *et al.* 1968 is widespread in the Romanian Carpathians, it being previously described in the Eastern, Southern and Western Carpathians [1, 10, 13, 15, 19-21, 24, 26].

The association *Festuco drymeiae-Fagetum* Morariu *et al.* 1968 (Fig. 2) is the most prevalent association in the pure European beech forests of the Orăştie river basin (Şureanu Mountains). 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, *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955. Former contributions to the study of the pure European beech forests brought Borza 1959 [3] in the neighbouring Sebeşului Valley (Şureanu Mountains), and Balazs (1993) [2] listed 38 species from the same territory we have analysed.

Figure 2. Association *Festuco drymejae-Fagetum* Morariu *et al.* 1968 (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 2009 and 2011 targetting all types of sites indicative of the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964) [6], 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) [4]. The associations were identified using the characteristic species, without neglecting the differential and dominant species [4, 8, 11].

In order to thoroughly identify the phytocenoses of the association, we performed a total of 30 phytocoenologic sampling incursions or relevées, of which 10 relevées were included in the synthetic table of the association (Table 1). The sampling sites were carefully chosen within the characteristic patches of the phytocoenoses, and were 400 square metres of size [4, 8].

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) [5], and we penciled in the overall vegetation coverage using the method designed by Tüxen (1955) [30] and Ellenberg (1974) [12].

The phytocoenologic table of the association was structured according to the methodology designed by Braun-Blanquet (1964) [6] and improved by Ellenberg (1974) [12]. 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) [29], Braun-Blanquet (1964) [6], Borza et Boşcaiu (1965) [4], Soó (1964-1980) [27], as well as the more recent papers by researchers such as Mucina *et al.* (1993) [16], Sanda (2002) [22], Sanda et. al (2008) [25]. In order to position the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968 (analysed by us in this paper) into the superior coeno-taxonomic units we referred to Sanda *et al.* (2008) [25].

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) [5], Cristea *et al.* (2004) [8].

The nomenclature of taxa was done according to Ciocârlan (2009) [7], 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 [8, 23].

RESULTS

The phytocoenoses of the association were identified in the following places: Tâmpu (pristine forest), Muchia Davidoi (Sibişelului Valley), Bunei (Sibişelului Valley), Lupşei Ridge (Sibişelului Valley), the Dacian fortress Sarmisegetuza Regia (archaeologic site enlisted as UNESCO World Heritage) [33].

The beech forests with *Festuca drymeja* (Table 1) can be found on slopes with discrete exposition (S, SW, W, E, NE, NW), with a drop of 28° - 43°, at altitudes of 780 - 1300 m, covering oligobasic brown earths (dystricambosoils), developed on crystalline schists as a rule.

The physiognomy and the floristic composition. These are natural quasi-pristine forests, with trees 110-180 years old and wood trunks felled by hazards (5-8%) and decayed. The floristic inventory of European beech forests with *Festuca drymeja* totals 105 species, which underlines a rich biodiversity. Out of the total number of species, 82 of them all (78.09%) belong to the coenotaxa subordinating the association, and 23 species (21.90%) 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, Ulmus glabra, Cerasus avium, Betula pendula, Acer platanoides*, *Carpinus betulus, Fraxinus excelsior, Picea abies*. The canopy coverage is around 0.7-0.9. The trunk diameters vary between 36 and 75 cm, while they rise up to 24 - 32 m tall.

The undergrowth and the offspring cover roughly 5% - 10% of the area and consist of the following species: *Fagus sylvatica* ssp. *sylvatica, Acer pseudoplatanus, Abies alba, Ulmus glabra, Cerasus avium, Betula pendula, Carpinus betulus, Fraxinus excelsior, Picea abies, Acer platanoides, Cornus mas*.

The undergrowth species, unevenly dispersed in the wooded area, consist of the following: *Cornus mas, Corylus avellana, Sambucus nigra, Cornus sanguinea, Euonymus verrucosa, Rubus idaeus, Rosa canina*, *Clematis vitalba*.

The herbaceous layer with a coverage of 30% to 75%, is dominated by *Festuca drymeja*, the characteristic species and the one that defines the association. The rest of this sinusia's spectrum of species subordinates to the **suballiance *Symphyto-Fagenion*** Boşcaiu *et al.* 1982 (*Dentaria glandulosa*, *Symphytum cordatum, Hieracium transsylvanicum*), then to the **alliance *Symphyto cordati-Fagion*** Vida 1959 (*Pulmonaria rubra*), after that to the **order *Fagetalia sylvaticae*** (*Galium odoratum, Rubus hirtus, Actaea spicata, Epilobium montanum, Sanicula europaea, Oxalis acetosella, 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: *Dentaria bulbifera, Luzula luzuloides, Mycelis muralis, Athyrum filix-femina, Glechoma hirsuta, Impatiens noli-tangere, Circaea lutetiana, Geranium robertianum, Poa nemoralis*.

The life forms spectrum of the association under consideration (Fig. 3) highlights the numerical prevalence of hemicryptophytes (H = 59.04%), 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 = 20.93% of which: MPh = 11.42%, mPh = 5.71%, nPh = 3.80%) as they are the basic constituents of forests. The geophytes (G = 12.38%) 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 terophytes (Th + TH = 5.70%) with a poor percentage, illustrate a low anthropic impact on flora and vegetation. The chamaephytes (Ch = 1.90%), 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 = 44.76%), followed by those European (E = 21.90%), with their genetic centre in the regions with a mild temperate climate of Europe, and those Central-European (Ec = 14.28%), 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 (Circ = 5.71%), and those Alpine-Balkan (Alp-B = 0.95%) 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 (2.85%), Atlantic-Mediterranean (Atl-Med) and Pontic-Mediterranean (P-M), 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 = 4.76%), of those Cosmopolitan (Cosm = 2.85%) with the widest spreading on Earth, and of the Carpathian endemisms (End–Carp =1.90%), not to be found elsewhere in the world [7, 8].

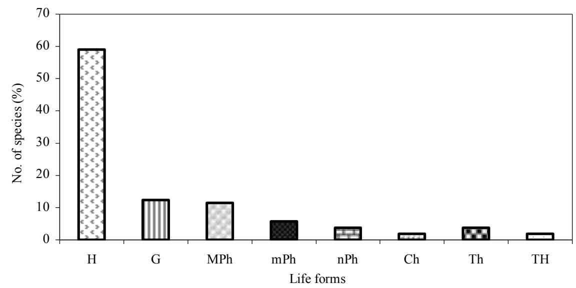

Figure 3. Life forms spectrum of the association *Festuco drymeiae-Fagetum* Morariu *et al.* 1968, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch- Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual terophytes; TH – Biannual terophytes.

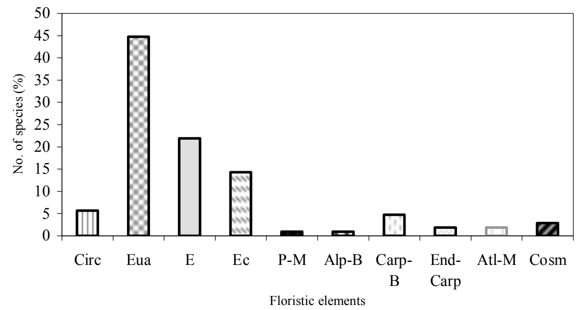

Figure 4. Spectrum of floristic elements for the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, where: Circ-Circumpolar; Eua - Eurasian; E - European; Ec - Central European; P-M – Pontic-Mediterraneean; Alp-B – Alpino-Balkanic; Carp-B = Balkan-Carpathian; End-Carp - Carpathian endemism; Atl-M - Atlantic-Mediterraneean; Atl-M - Atlantic-Mediterranean; Cosm – Cosmopolitan.

The analysis of the diagram of ecological indices (Fig. 5) reveals a majority of mesophylous species ($U_{3-3.5}$ = 64.76%), followed by xero-mesophylous species ($U_{2-2.5}$ = 21.90%), meso-hygrophylous ($U_{4-4.5}$ = 10.47%), as well as the hygrophylous ($U_{5-5.5}$ = 1.90%) and amphitolerant species (U_0 = 0.95). If analysed thermically, one can notice the dominance of micro-mesothermophylous species ($T_{3-3.5}$ = 66.66%), followed by microthermophylous ($T_{2-2.5}$ = 20.95%), eurithermophylous (T_0 = 11,42%) and moderate-thermophylous ($T_{4-4.5}$ = 0.95%). The presence of dystricambosoils reflect a high percentage of acid-neutrophylous species (R_3 = 37.14%), followed by those weakly acid-neutrophylous (R_4 = 30.47%), euri-ionical (R_0 = 18.09%), acidophylous (R_2 = 11.42%), neutral-basiphylous (R_5 = 1.90%) and strongly acidophylous (R_1 = 0.95%). Upon analysing the diagram below it goes that the phytocoenoses of the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, are mesophylous, microthermophylous and acid-neutrophylous.

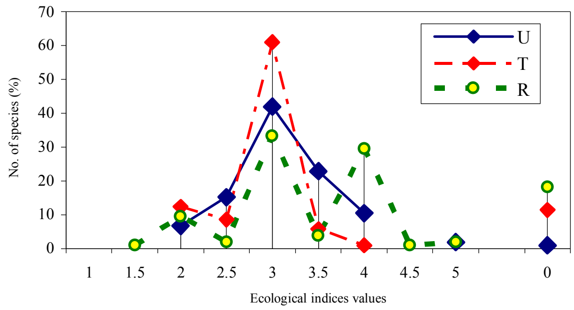

Figure 5. Diagram of ecological indices for the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, where: U - humidity, T - temperature, R - the chemical reaction of the soil.

DISCUSSION

The research we conducted in the Orăştie river basin between the years of 2009 and 2011 underlined the fact that the vegetation of this kind of arboretum is best represented by the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, it being poorly researched in Romania.

The association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, analysed herein, is stable as to the ecological dynamics and equilibrium. It is also worth mentioning that we identified in these European beech forests with *Festuca drymeja* two Carpathian endemisms (*Dentaria glandulosa, Symphytum cordatum*) as well as three species listed in red among the vascular plants of Romania (*Platanthera bifolia, Cephalanthera longifolia, Cephalanthera rubra*) [7, 9, 17].

If compared to those from the Someşului Cald Valley (Cluj County, the Apuseni Mountains), described by Pop *et al.* (2002) [21], the European beech forests with *Festuca drymeja* we researched in the Orăştie river basin (Şureanu Mouintains), one can see many similarities and few differences.

The floristic inventory of the beech forests with *Festuca drymeja* from the Orăştie river basin totals 105 species, of which 82 species (78.09%) belong to the caenotaxa subordinating the association, whereas similar beech forests from the Someşului Cald Valley comprise 49 species, of which 37 species (75.51%) belong to the same caenotaxa.

The life forms spectrum reveals the prevalence of hemicryptophytes 59.04% (Orăştie river basin, Şureanu Mountains), 60.40% (Someşului Cald Valley, Apuseni Mountains), followed by phanerophytes 20.93% (Orăştie river basin, Şureanu Mountains), 20.90% (Someşului Cald Valley, Apuseni Mountains).

On analysing the floristic elements spectrum for the phytocoenoses of the association *Festuco drymejae-Fagetum* Morariu *et al.* (1968) in the two regions under scrutiny, one notices that in the Orăştie river basin (Şureanu Mountains) there are Atlantic-Mediterranean elements (1.90%) as well as Pontic-Mediterranean ones (0.97%), due to the eastbound incursions of warm air masses through the Mureşului and Orăştiei valleys, which is not the case with the Someşului Cald Valley [29]. In the Someşului Cald Valley (Apuseni Mountains) there are elements of Mediterranean origin (2.10%) which do not exist in the Orăştie river basin (Şureanu Mountains). The presence of these southern elements in the Someşului Cald Valley relates to the existence of certain sunny and cold-proof stands where the supramediterranean-like climate bears an influence [8].

On analysing the data from the diagram of ecological indices we conclude that the European beech forests with *Festuca drymeja* from the two river basins (Orăştie and Someşul Cald) have a strong mesophylous, micro-mesothermophylous character, growing on acid brown earths, as seen from the prevalence of acid-neutrophylous, weakly acid-neutrophylous and euri-ionical species [21].

The percentage differences with respect of the physiognomy and floristic composition, the ecological indices, the life forms, and the floristic elements are due to the different positioning (altitude, climate, land forms, rock formations, soil) of the two geographic regions harbouring the phytocoenoses of the association under scrutiny, as well as to the human impact on the European beech forests with *Festuca drymeja* in the two hydrographic basins, Orăştie, Şureanu Mountains and Someşul Cald, Apuseni Mountains.

The ligneous species *Fagus sylvatica* subsp. *sylvatica*, which is a trait for the association *Festuco drymejae-Fagetum* Morariu *et al.* 1968, stretches upward to the altitude of 1300 m in the Orăştie river basin (Şureanu Mountains), whereas on the Codlei Massif (Curvature Carpathians) it occurs up to the altitude of 1150 m [15]. 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 [15].

The altitudinal range of the Sessile oak is often times determined by the particularities of the local climate (warm stands), as well as the geomorphological and soil favouring conditions [28]. The ligneous species *Quercus petraea* and *Quercus dalechampii* occur scarcely in the phytocoenoses described by Morariu et. al (1968) [15] at heights of 620-760 m; the absence of these species in the phytocoenoses researched in the Orăştie river basin owes much to the higher altitudes in this region (780-1300 m), where the Sessile oak species no longer find favourable growing conditions. In the same way, other facts speak out: the characteristic species in the ***Lathyro hallersteinii-Carpinenion*** Boşcaiu *et al.* 1982 **suballiance** (phytocoenoses of hornbeam mixed with Sessile oak, beech, and oak), *Carex pilosa*, *Vinca minor* and

Table 1. Association *Festuco drymejae-Fagetum* Morariu *et al.* 1968 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.)	1300	790	810	780	910	920	930	914	920	1200		
					Exposition	W	NW	E	NE	S	SW	SW	W	SW	E		
					Slope (^{0})	34	38	42	38	43	31	30	28	31	33		
					Hight of the trees (m)	32	25	24	25	26	32	31	28	30	32		
					Trunk diam. (cm)	60	70	60	75	36	64	44	60	42	68		
					Consistency of tree layer (%)	0.9	0.9	0.9	0.9	0.7	0.7	0.7	0.7	0.7	0.9		
					Herbaceous cover layer (%)	50	30	35	30	35	60	65	50	60	75		
					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
G	Carp-B	4	2	3	*Festuca drymeja*	3	2	2	2	2	3	3	3	3	3	V	34.50
MP	E	3	3	0	*Fagus sylvatica* subsp. *sylvatica*	5	5	5	5	4	4	4	4	4	5	V	68.75
					Symphyto-Fagenion												
G	End-Carp	4	2.5	4	*Dentaria glandulosa*	.	.	.	.	.	+	.	.	+	.	I	0.10
H	End-Carp	3	2	3	*Symphytum cordatum*	.	.	+	.	.	.	.	.	.	+	I	0.10
H	B-Carp	3	0	0	*Hieracium transsylvanicum*	.	.	.	.	.	.	+	.	.	.	I	0.05
					Symphyto cordati-Fagion												
MPh	Ec	3.5	3	3	*Acer pseudoplatanus*	.	.	.	.	1	1	.	.	1	+	II	1.50
H	Carp-B	3.5	2	3	*Pulmonaria rubra*	.	.	.		.	1	+	+	.	+	II	0.65
MPh	Ec	4	3	0	*Abies alba*	+	.	.	.	.	.	1	.	+	.	II	0.60
					Fagetalia sylvaticae												
G	Eua	3	3	3	*Galium odoratum*	.	+	1	+	+	.	+	+	+	2	IV	3.45
H	E	3.5	3	4	*Mercurialis perennis*	.	.	.	+	+	+	1	+	+	1	IV	1.70
H	Ec	3	0	4	*Galeobdolon luteum*	+	+	+	+	.	.	.	+	.	+	III	0.30
H	Eua	3	2.5	2	*Rubus hirtus* subsp. *hirtus*	1	+	.	.	+	+	.	+	.	+	III	0.75
Ch	E	3	3.5	4	*Euphorbia amygdaloides*	.	+	.	+	+	.	+	.	+	+	III	0.30
H	Eua	3.5	3	3	*Actaea spicata*	.	+	.	.	.	.	+	+	+	+	III	0.25
H	Eua	3	0	3.5	*Epilobium montanum*	.	.	.	+	.	.	+	+	+	+	III	0.25
H	Eua	3.5	3	4	*Sanicula europaea*	.	.	.	.	+	.	+	+	+	+	III	0.25
H	Circ	4	3	3	*Oxalis acetosella*	+	.	.	.	+	.	+	+	+	.	III	0.25
H	Eua	3.5	3	4	*Asarum europaeum*	.	.	.	.	+	1	+	.	.	+	II	1.55
H	Eua	3.5	3	4	*Salvia glutinosa*	.	+	.	.	+	.	.	+	.	+	II	0.20
H	Circ	3.5	3	4	*Carex sylvatica*	.	+	.	.	.	.	.	.	+	+	II	0.15
H	Ec	3	3.5	3	*Isopyrum thalictroides*	.	.	+	.	+	.	.	.	.	+	II	0.15
H	Eua	3.5	0	4	*Paris quadrifolia*	.	.	.	.	+	.	.	.	+	+	II	0.15
H	Eua	3.5	3	0	*Scrophularia nodosa*	.	.	.	.	+	.	+	.	.	+	II	0.15
H	Eua	3	2	0	*Campanula rapunculoides*	.	.	.	+	+	.	.	.	.	.	I	0.10
H	Eua	3	3	3	*Lathyrus vernus*	.	.	.	.	+	.	.	.	.	.	I	0.05
H	Ec	3	3	3	*Symphytum tuberosum*	.	.	.	+	.	.	.	.	.	.	I	0.05
					Querco-Fagetea												
G	Ec	3	3	4	*Dentaria bulbifera*	.	+	+	+	+	+	+	+	+	+	V	0.45
H	E	2.5	2.5	2	*Luzula luzuloides* subsp. *luzuloides*	+	+	+	+	.	1	+	+	+	+	V	1.35
H	E	3	3	0	*Mycelis muralis*	+	+	+	+	+	.	+	+	+	+	V	0.45
H	Cosm	4	2.5	0	*Athyrum filix-femina*	+	.	.	+	.	+	+	+	1	+	IV	0.80
H	P-Med	2.5	3	4	*Glechoma hirsuta*	.	.	.	+	+	+	+	+	+	.	III	0.75
Th	Eua	4	3	4	*Impatiens noli-tangere*	+	+	.	.	.	+	+	+	.	+	III	0.30
mPh	Eua	4	3	3	*Ulmus glabra*	+	.	.	+	+	.	.	+	+	+	III	0.30

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
G	Eua	3.5	3	4	*Circaea lutetiana*	.	+	.	.	+	+	.	.	+	+	III	0.25
Th	Cosm	3.5	3	3	*Geranium robertianum*	.	+	.	.	.	+	+	+	.	+	III	0.25
MPh	E	3	3	3	*Acer platanoides*	+	+	+	.	+	+	.	.	.	+	III	0.25
MPh	Eua	3	2	2	*Populus tremula*	.	.	+	+	.	+	+	1	.	.	III	0.70
H	Eua	3	3	0	*Poa nemoralis*	.	+	+	+	.	.	.	.	+	.	II	0.20
H	E	3.5	3.5	3.5	*Polystichum aculeatum*	.	.	.	.	.	+	+	+	+	.	II	0.20
mPh	E	3	3	3	*Cerasus avium*	.	+	+	.	+	+	.	.	.	.	II	0.20
MPh	Eua	3	2	2	*Betula pendula*	.	+	+	+	.	.	.	.	.	.	II	0.15
H	E	3	3	3	*Carex digitata*	.	+	1	.	+	.	.	.	.	.	II	0.60
G	E	2.5	3	4	*Cephalanthera longifolia*	.	+	.	.	+	.	.	+	.	.	II	0.15
H	Eua	4	3	0	*Dryopteris filix-mas*	.	.	+	.	.	.	.	.	+	+	II	0.15
H	Ec	4	3	4	*Lunaria rediviva*	.	.	.	.	.	+	+	.	+	.	II	0.15
MPh	E	3	3	3	*Sambucus nigra*	.	+	.	.	.	.	.	+	.	+	II	0.15
H	Eua	3.5	0	0	*Stachys sylvatica*	.	.	.	.	.	+	+	+	.	.	II	0.15
G	Circ	3.5	3	0	*Anemone nemorosa* subsp. *nemorosa*	.	.	+	.	.	+	.	+	.	.	II	0.15
MPh	E	3	3	4	*Fraxinus excelsior*	.	.	.	.	+	.	+	+	.	.	II	0.15
H	Eua	3	3	4	*Brachypodium sylvaticum*	.	.	+	.	+	.	.	.	.	+	II	0.15
G	Eua	3	3	3	*Lathraea squamaria*	.	.	.	.	+	+	.	.	+	.	II	0.15
MPh	E	2.5	3	3	*Acer campestre*	.	.	.	.	+	.	.	+	.	.	I	0.10
H	Atl-M	3	3	3	*Atropa belladona*	.	+	.	+	.	.	.	.	.	.	I	0.10
H	Eua	3	3	0	*Campanula persicifolia*	.	+	.	.	.	.	+	.	.	.	I	0.50
H	Eua	2.5	3	3	*Carex pilosa*	.	.	.	+	.	.	.	.	.	+	I	0.10
MPh	E	3	3	3	*Carpinus betulus*	.	+	.	+	.	.	.	.	.	.	I	0.10
mPh	E	3	3	3	*Corylus avellana*	.	.	.	.	+	.	+	.	.	.	I	0.10
H	Eua	3	2	2	*Cruciata glabra* subsp. *glabra*	.	+	+	.	.	.	.	.	.	.	I	0.10
H	Circ	2.5	3	2.5	*Hieracium umbellatum*	+	+	.	.	.	.	.	.	.	.	I	0.10
H	Eua	3	0	3	*Hieracium murorum*	.	.	.	.	+	.	+	.	.	.	I	0.10
Th	Eua	2.5	3	3	*Lapsana communis*	.	.	.	.	.	.	+	.	+	.	I	0.10
H	E	2.5	3	4	*Melica uniflora*	.	+	.	.	+	.	.	.	.	.	I	0.10
Th	Eua	2.5	3	3	*Moehringia trinervia*	.	+	+	.	.	.	.	.	.	.	I	0.10
G	Eua	3.5	0	0	*Petasites albus*	.	.	.	.	.	.	+	.	.	+	I	0.10
G	E	3	2.5	2,5	*Polygonatum verticillatum*	+	.	.	.	.	.	.	+	.	.	I	0.10
H	Ec	3	2.5	0	*Prenanthes purpurea*	.	.	.	.	.	.	+	.	+	.	I	0.10
H	Eua	3.5	2	0	*Vicia sylvatica*	.	+	+	.	.	.	.	.	.	.	I	0.10
H	Eua	3	3	3.5	*Viola reichenbachiana*	.	+	.	.	.	.	+	.	.	.	I	0.10
H	E	2	4	4	*Vincetoxicum hirundinaria*	.	.	.	.	+	.	.	+	.	.	I	0.10
H	Eua	3	3	4	*Anthriscus sylvestris*	.	.	.	.	.	.	.	.	.	+	I	0.05
G	E	2	3	5	*Cephalanthera rubra*	.	.	.	.	+	.	.	.	.	.	I	0.05
nPh	Ec	3	3	3	*Clematis vitalba*	.	.	.	.	+	.	.	.	.	.	I	0.05
mPh	Ec	3	3	4	*Cornus sanguinea*	.	.	.	.	+	.	.	.	.	.	I	0.05
mPh	E	2.5	3	4	*Euonymus verrucosa*	.	.	.	.	+	.	.	.	.	.	I	0.05
G	Ec	2.5	3	3	*Galium schultesii*	.	.	.	.	+	.	.	.	.	.	I	0.05
H	Eua	3	3	4	*Geum urbanum*	.	.	.	.	.	.	.	.	.	+	I	0.05
nPh	Atl-M	3	3	3	*Hedera helix*	.	.	.	.	+	.	.	.	.	.	I	0.05
G	Eua	3.5	0	3	*Platanthera bifolia*	+	.	.	.	.	.	.	.	.	.	I	0.05
H	Carp-B	2.5	3	4	*Helleborus purpurascens*	.	.	.	.	+	.	.	.	.	.	I	0.05
nPh	E	2	3	3	*Rosa canina*	.	.	.	.	+	.	.	.	.	.	I	0.05

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
H	E	3.5	3	3	*Stellaria nemorum*	+	.	.	.	.	.	.	.	.	.	I	0.05
Ch	Eua	2	2	2	*Veronica officinalis*	.	+	.	.	.	.	.	.	.	.	I	0.05
					Vaccinio-Piceetea												
MPh	E	0	0	0	*Picea abies*	+	.	.	.	.	.	.	.	+	.	I	0.10
MPh	Eua	3	2.5	2	*Sorbus aucuparia*	.	.	.	.	.	.	.	.	+	+	I	0.10
TH	Carp-B	3.5	2	2	*Campanula abietina*	+	.	.	.	.	.	.	.	.	.	I	0.05
					Epilobietea angustifolii												
H	Eua	2.5	3	2	*Calamagrostis arundinacea*	+	.	.	.	+	.	1	.	.	.	II	0.60
H	Eua	2	3	0	*Calamagrostis epygeios*	+	.	.	.	.	.	.	+	.	.	I	0.10
H	Eua	4	3	4	*Cirsium oleraceum*	.	.	.	+	.	.	.	.	.	+	I	0.10
H	Eua	3	2	0	*Galeopsis speciosa*	.	.	.	.	.	+	.	.	.	+	I	0.10
nPh	Circ	3	3	3	*Rubus idaeus*	+	.	.	.	.	.	+	.	.	.	I	0.10
					Quercetea pubescenti-petraeae												
G	Eua	3	0	4	*Lilium martagon*	+	.	.	.	.	+	.	.	.	.	I	0.10
H	Ec	2.5	3	5	*Melittis melissophyllum* subsp. *melissophyllum*	.	.	.	.	+	.	.	+	.	.	I	0.10
mPh	Ec	2	3.5	4	*Cornus mas*	.	.	.	.	+	.	.	.	.	.	I	0.05
					Varyae sintaxa												
H	Cosm	3	3	4	*Urtica dioica* subsp. *dioica*	.	+	.	.	.	.	+	.	+	.	II	0.15
H	Circ	2.5	3	3	*Solidago virgaurea*	.	.	.	.	+	+	+	.	.	.	II	0.15
H	Ec	3.5	2	3	*Doronicum austriacum*	+	.	.	.	.	.	+	.	.	.	I	0.10
H	Eua	3	0	3	*Galium mollugo*	.	.	+	.	.	.	.	.	+	.	I	0.10
H	Ec	3.5	2.5	2	*Luzula sylvatica*	.	+	.	.	.	.	+	.	.	.	I	0.10
H	Eua	3.5	0	4	*Silene dioica*	.	.	.	.	.	+	+	.	.	.	I	0.10
H	Eua	4	2.5	1.5	*Calamagrostis villosa*	.	.	.	.	.	.	.	.	+	.	I	0.05
H	Alp-B	3.5	2	3.5	*Doronicum columnae*	.	.	.	.	.	.	.	+	.	.	I	0.05
H	Eua	5	3	0	*Myosottis scorpioides*	.	.	.	.	.	.	.	+	.	.	I	0.05
H	Eua	5	3.5	4.5	*Scrophularia umbrosa*	.	.	.	.	+	.	.	.	.	.	I	0.05
H	Eua	2.5	3.5	4	*Verbascum blattaria*	.	.	.	.	.	.	+	.	.	.	I	0.05
TH	Eua	2	3	4	*Verbascum nigrum*	.	.	.	.	+	.	.	.	.	.	I	0.05

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual terophytes; TH – Biennial terophytes
F.e. - floristic elements; Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; End-Carp. - Carpathian Endemism; Cosm - Cosmopolitan; Atl-M - Atlantic-Mediterranean; Carp-B – Carpatho-Balkan; P-Med – Ponto-Mediterranean; Alp-Balc – Alpine-Balkan.
U - humidity, T - temperature, Sr - the chemical reaction of the soil, K - constance, ADm - average abundance-dominance.
Place and date of mapping: 1 – Tâmpu pristine forest, 10.08.2010; 2-3 – Muchia Davidoi (Sibişelului Valley), 02.08.2010; 4 – Bunei (Sibişelului Valley), 02.08.2010; 6-8 – Prislop (Sibişelului Valley), 21.07.2011; 9 – Culmea Lupşei (Valea Sibişelului), 21.07.2011; 10 – Sarmizegetusa Regia (archaeologic site, Grădiştea de Munte), 30.08.2009

Stellaria holostea, are usually present in the forests on the Codlei Massif, sometimes also determining facies (*Carex pilosa*, *Vinca minor*), whereas in the Orăştie river basin these species have a poor occurrence (*Carex pilosa*) or none (*Stellaria holostea*, *Vinca minor*) [15].

The European beech forests with *Festuca drymeja* identified at Sarmizegetusa Regia (archaeologic site on the UNESCO World Heritage List) and at Tâmpu (primeval forests) [30], with a high degree of naturalness, are included in the completely protected area of the Grădiştea Muncelului-Cioclovina Natural Park [33, 34]. The ecological value and the importance of preserving these natural forests, extinct in so many European countries, but still present in our country, including the Orăştie river basin, is confirmed by the following facts:

- rare and endemic species, historical monuments are found here;
- there are remnants of the once pristine forests here;
- they are sanctuaries of biodiversity (105 species of plants);
- they have a great role in protecting the slopes against erosion;
- they are valuable gene vaults ensuring the perenity of species in this territory;
- they are sources of scientific information for the sustainable management of cultivated forests [34].

We consider that the beech forests of Sarmizegetusa Regia and Tâmpu (Orăştie river basin, Şureanu Mountains) have a ″high conservational value″ [14], since these wooded areas shelter endemic or endangered species, historic monuments, such as Sarmizegetusa Regia (archaeologic site on the UNESCO World Heritage List), a priceless vestige, well-known worldwide.

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Received: 5 February 2012
Accepted: 13 March 2012
Published Online: 19 March 2012
Analele Universităţii din Oradea – Fascicula Biologie
http://www.bioresearch.ro/revistaen.html
Print-ISSN: 1224-5119
e-ISSN: 1844-7589
CD-ISSN: 1842-6433