CONTRIBUTIONS TO THE PHYTOCOENOLOGIC STUDY IN PURE EUROPEAN BEECH STAND FORESTS IN CODRU-MOMA MOUNTAINS (NORTH-WESTERN ROMANIA)

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Abstract. In the present work we present a phytocoenologic study on the associations found in pure European beech stand forests in Codru-Moma Mountains namely: *Festuco drymejae-Fagetum* Morariu et al. 1968, *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955.

Characterization of the associations we studied and presentation of the tables have been made considering the selection of the most representative relevées of pure European beech forests belonging to Codru-Moma Mountains.

The phytocoenoses of pure forest stands of European beech forests belonging to the two associations were analyzed in terms of floristic composition, life forms spectrum, spectrum chart of the floral elements and ecological indices.

Keywords: association, phytocoenoses, pure European beech, floristic elements, life forms, ecological indices.

INTRODUCTION

Codu-Moma Mountains region is well shaped, with conspicuous limits and is almost detached from the central Apuseni Mountains, appearing as a mountainous island mass surrounded by depressions (Fig. 1). Codru-Moma Mountains occupies a large area in the North-West of Romania, making it comparable with other mountains of the country, like Pădurea Craiului or Plopiş Mountains. The maximum height is reached in top Pleşu, 1112 m.

Figure 1. The location of Codru-Moma Mountains in Romania [17].

Codru-Moma consist of Paleozoic and Mesozoic formations, plus in a small extent, tertiary volcanic rocks [15]. They have a typical structure displayed in sariaj blades, ie superimposed tectonic units, that appeared as a result of folding movements that took place during the last period of the Mesozoic era, the Cretaceous [15]. This makes the surface formations to form a mosaic.

Codru-Moma Mountains group is formed of two distinct mountains - Codru and Moma Mountains, quite clearly separated by two diverging valleys: Briheni Valley (in the east) and Moneasa Valley (in the west). Codru Mountains occupies the northern and south-west part of the massif and Moma Mountains lies in the south-east.

Association *Festuco drymejae-Fagetum* Morariu et al. 1968, is widespread in the Romanian Carpathians, as described in Moldova, in Transylvania, in northwestern Romania and in Banat [6-8, 12]. In this association the tree layer is dominated by beech (*Fagus sylvatica*), being accompanied by hornbeam (*Carpinus betulus*), oak (*Quercus petraea*) and birch (*Betula pendula*).The shrub layer is poorly developed, in some places it is nonexistent. Instead the synusium grass presents a considerable density and is dominated by *Festuca drymeja.*

Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, integrates acidophilous pure European beech forests in Codru-Moma, that can be found on slopes with very high degrees of inclination [14]. This association was described in Transylvania, in Oltenia, in Moldova and in northwestern Romania [9, 10, 12-14]. Soils prevailing in this association are the brown acid forest ones. The tree layer is dominated in this case too by beech (*Fagus sylvatica*), and the sinusitis grass is well represented by *Luzula luzuloides*.

Contributions to the study of flora and vegetation of Codru-Moma Mountains has brought Paucă (1941) [11] and Ardelean (2002) [1].

MATERIALS AND METHODS

The study was carried out between 2008-2009 and tried to identify the phytocoenoses of *Fagus sylvatica* with *Festuca drymeja* and *Fagus sylvatica* with *Luzula luzuloides*, in Codru-Moma Mountains. In order to do this, a number of 18 phytocoenological relevées were made which included the pure European beech forests from Codru-Moma Mountains.

While ordering species in associations charts, as well as their classification in their correspondent taxa: suballiance, alliance, order and class the traditional flower-environment systems were taken into account, namely those belonging to Tuxen (1995) [16], Ellenberg (1974) [5], and recent critical systems (recently published) belonging to V. Sanda et all. (2008) [14].

The research methods on vegetation adopted are

those elaborated by J. Braun-Blanquet (1928) [2], and adapted to particularities of Codru Moma Mountains' vegetation. In terms of technical reports and making notations on the structure of the analyzed communities the indications of Romanian authors were taken into account [4].

The quantitative criteria for the two associations studied in this research are the abundance and dominance with the establishment of the classes of constancy (K = I-V) [2, 5, 16].

Simultaneously with constituent taxa registration, and according to Braun-Blanquet scale, both vegetation' abundance and dominance were registered in relevées through summing up the abundance average and correspondent coverage rate in percents to each scale value.

Floristically and physionomically homogeneous sample areas were selected in the characteristic fragments of phytocoenoses, their size being 400 m² [3].

RESULTS

In pure European beech forests from Codru-Moma Mountains the following forest associations were identified:

- *Festuco drymejae-Fagetum* Morariu et al. 1968;
- *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955.

Association ***Festuco drymejae-Fagetum*** Morariu et al. 1968

The phytocoenoses of this association have been identified in Codru-Moma Mountains in the following 11 localities, namely: Huta Valley (Finiş village), Pojaru Hill (Finiş village), Izbuc (Finiş village), Botfei Valley (Botfei village), Urviş Valley (Urviş village); Clit Valley (Clit village); Cirgău Brook (Tărcaia village) Crişului Văratec Valley (Briheni village); Pontu Valley (Şuncuiuş village); Ormanu Valley (Şoim village), Şoimului Valley (Şoim village).

The association (Fig. 2) can be found on slopes with different inclination, between 2° and 35°, at altitudes of 500-800 m. The consistency of forest stands is usually between 80% and 100%. Tree trunk thickness varies between 20 and 70 cm and their height between 20 and 28 meters. The herbaceous layer coverage varies between 20% and 90%.

Figure 2. Association *Festuco drymejae-Fagetum* Morariu et al. 1968, Urviş Valley (Urviş village - Arad County).

Association *Festuco drymejae-Fagetum* Morariu et al. 1968, is found on limestone bedrocks which have rocks on the surface or cell debris or semimobil. Characteristic soils belonging to this pure European beech association are of brown eumesobasic and rendzinic type.

Coenotaxonomically the association falls as follows:

Class ***QUERCO-FAGETEA*** Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi 1996;

Order ***Fagetalia sylvaticae*** Pawlowscki in Pawlowscki et al. 1928;

Alliance ***Symphyto cordati-Fagion*** Vida 1963;

Suballiance ***Symphyto-Fagenion*** Boşcaiu et al. 1982;

Association *Festuco drymejae-Fagetum* Morariu et al. 1968.

From the species characteristic of alliance, order and class one can note: *Acer pseudoplatanus*, *Cardamine glanduligera*, *Pulmonaria rubra*, *Euphorbia amygdaloides*, *Lamium galeobdolon*, *Mercurialis perennis*, *Salvia glutinosa*, *Erythronium dens-canis*, *Hedera helix*, *Mycelis muralis*.

The floristic inventory of European beech with *Festuca drymeja* totals 118 species (Table 1).

Analyzing the floristic elements (Fig. 3), one can observe the prevalence of eurasian species (Eua=47.7%), followed by european (E=18.7%) and circumpolar (Cp=8.4%) ones. The eurasian species that have the greatest consistency in *Festuco drymejae-Fagetum* association Morariu et al. 1968 include: *Rubus hirtus*, *Carex pilosa*, *Galium odoratum*, *Lamium galeobdolon*, *Mercurialis perennis*, *Dryopteris filix-mas*, *Viola reichenbachiana*. Arid temperate climate illustrates the large share of Eurasian plants within this area, with their genetic origin emerging both from Europe and Asia, while the moderate climate suggests the presence of European varieties, genetically originating in Europe.

Spectrum of life forms (Fig. 4), highlights the numerical predominance of hemicryptophytes (H=50%), followed by geophytes (G=23.6%) and megaphanerophytes (MPh=13%). Due to the influence of temperate climate, in the area covered by our research, the herbal vegetation is abundant, the largest share belonging to hemicryptophytes. The large share of hemicryptophytes varieties within the Codru Moma Mountains area is natural, due to herbal species migration during the phytho-historic evolution, from lawns towards forests, as well as due to natural phenomena (trees falls caused by winds and snows) and irrational wood exploiting activities.

The diagram of the ecological indices (Fig. 5) shows that most species of the association are mezophyle in terms of humidity ($U_{3-3.5}$=67%), followed by xero-mesophilous ($U_{2-2.5}$=12%) ones. The high percentage of mezophyles shows that phytocoenoses of *Fagus sylvatica* with *Festuca drymeja* are quartered on the northern shady slopes, on wet soils, with sufficient moisture in soil and air.

Table 1. Association *Festuco drymejae-Fagetum* Morariu et al. 1968 in Codru-Moma Mountains.

L.f.	F.e.	U	T	S.r.	**Number**	1	2	3	4	5	6	7	8	9	10	11	K	ADm
					Altitude (m.s.m.)	770	800	700	650	700	550	500	650	700	400	600		
					Exposition	N	N	V	N	N	NV	N	N	NV	NE	NV		
					Slope (degree) (º)	15	10	2	20	20	15	35	25	10	25	20		
					Hight of the trees (m)	28	25	26	24	22	20	26	22	28	25	24		
					Consistency of tree layer	1	1	0.7	0.9	0.8	0.9	0.8	0.8	1	0.9	0.9		
					The grass layer (%)	60	90	30	15	15	10	25	25	25	65	35		
					Area (m²)	400	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**	**18**
MPh	E	3	3	0	As. *Fagus sylvatica*	5	5	4	5	5	5	5	5	5	5	5	V	85.23
H	E	4	2	3	As. *Festuca drymeja*	1	1	2	+	1	+	1	1	+	1	2	V	6.04
					Symphyto-Fagenion, Symphyto cordati-Fagion													
MPh	Eua	3.5	3	3	*Acer pseudoplatanus*	+	·	+	·	+	·	·	·	·	·	·	II	0.14
G	End. carp.	4	2.5	4	*Cardamine glanduligera*	3	·	+	·	·	·	·	+	+	+	+	III	3.64
H	Cp	2	0	1	*Deschampsia flexuosa*	·	·	·	+	+	·	·	·	·	·	·	I	0.09
H	Ec	3	4	4	*Euphorbia carniolica*	+	·	·	·	·	·	·	·	·	·	·	I	0.04
G	Cosm	3	3	0	*Pteridium aquilinum*	·	·	·	+	+	·	·	·	·	·	+	II	0.14
H	DB	3.5	2	3	*Pulmonaria rubra*	·	+	·	+	·	+	·	+	·	+	·	III	0.23
					Fagetalia sylvaticae													
H	Eua	3.5	3	3	*Actaea spicata*	·	·	·	·	·	·	+	·	·	·	·	I	0.04
G	E	3.5	3.5	4	*Allium ursinum*	+	·	·	·	·	·	+	·	1	3	·	II	3.95
G	Ec	3.5	3.5	4	*Arum maculatum*	·	·	·	·	·	·	·	+	+	·	·	I	0.09
H	Eua	3.5	3	4	*Asarum europaeum*	·	·	·	·	·	·	·	+	·	+	·	I	0.09
G	Ec	3	3	4	*Cardamine bulbifera*	+	+	+	·	·	·	+	+	+	+	+	IV	0.36
H	E	3	3	3	*Carex digitata*	+	+	+	·	+	+	·	+	+	+	·	IV	0.36
H	Eua	2.5	3	3	*Carex pilosa*	+	+	+	+	·	·	·	+	·	·	+	III	0.27
H	E	3.5	3	4	*Carex sylvatica*	·	+	·	·	+	·	·	·	+	+	·	II	0.18
G	Eua	3.5	3	4	*Circaea lutetiana*	·	+	+	·	·	·	·	·	·	·	·	I	0.09
G	Ec	3	3	0	*Corydalis cava*	·	·	·	·	·	·	·	+	+	+	·	II	0.14
G	Eua	3	3	0	*Coryalis solida*	·	·	·	·	·	·	·	+	+	+	·	II	014
nPh	Eua	3.5	3	3	*Daphne mezereum*	·	·	·	·	·	·	+	+	·	·	·	I	0.09
Ch	E	3	3.5	4	*Euphorbia amygdaloides*	·	·	+	·	·	·	+	·	+	+	·	II	0.18
G	E	3.5	3	4	*Galanthus nivalis*	·	·	+	·	·	·	·	·	+	+	·	II	0.14
G	Eua	3	3	3	*Galium odoratum*	+	+	+	+	·	+	+	+	+	+	+	V	0.91
G	Eua	2.5	3	3	*Galium schultesii*	·	·	·	·	·	·	+	·	+	·	·	I	0.09
H	Eua	3	3.5	3	*Isopyrum thalictroides*	+	+	·	·	·	·	·	·	·	+	·	II	0.14
H	Eua	3	0	4	*Lamium galeobdolon*	+	+	+	+	+	+	+	+	+	+	+	V	1.00
H	Eua	3.5	0	4	*Lamium maculatum*	·	·	·	+	+	·	·	·	·	·	+	II	0.14
G	Eua	3.5	3	4	*Mercurialis perennis*	+	+	+	·	·	·	+	·	+	+	·	III	0.27
G	Eua-M	3.5	3	3	*Neottia nidus-avis*	·	·	·	+	·	·	+	·	·	·	·	I	0.09
G	Cp	4	3	3	*Oxalis acetosella*	+	+	+	·	·	+	·	+	·	·	+	III	0.27
H	Eua	3.5	0	4	*Paris quadrifolia*	+	·	·	·	·	·	·	·	·	+	·	I	0.09
H	Eua	3	2	5	*Primula officinalis*	·	+	·	·	·	·	+	·	·	·	·	I	0.09
H	P-Pan	3	3	3	*Primula acaulis*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
nPh	Eua	3	2.5	3	*Rubus hirtus*	+	4	+	+	+	+	·	+	+	+	+	V	6.09
nPh	Cp	3	3	3	*Rubus idaeus*	·	+	·	·	·	·	·	·	·	·	·	I	0.04
H	Eua	3.5	3	4	*Salvia glutinosa*	·	+	+	·	·	·	+	·	+	+	·	III	0.23
H	Eua	3.5	3	0	*Scrophularia nodosa*	+	+	·	·	·	·	·	·	·	+	+	II	0.18
H	Eua	3.5	3	4	*Sanicula europaea*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
H	Eua	3	3	3	*Symphytum tuberosum*	·	·	·	·	·	·	+	+	+	+	·	III	0.18
					Querco-Fagetea													
MPh	Eua	2.5	3	3	*Acer campestre*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
MPh	Eua	3	3	3	*Acer platanoides*	·	·	·	·	·	·	+	·	·	+	·	I	0.09
G	Cp	3.5	4	0	*Anemone nemorosa*	+	1	+	·	·	·	+	+	+	+	·	IV	0.73
G	Eua	3.5	3	4	*Anemone ranunculoides*	+	·	+	·	·	·	·	·	+	+	·	II	0.18
H	Cosm	4	2.5	0	*Athyrium filix-femina*	+	+	+	·	·	·	·	+	+	·	+	III	0.27
H	Atl-M	3	3	3	*Atropa bella-donna*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
H	Eua	3	2	2	*Betula pendula*	+	·	·	+	+	·	·	·	+	·	+	II	0.23
H	Eua	2.5	3	2	*Calamagrostis arundinacea*	+	·	·	·	+	·	·	·	·	·	+	II	0.14
MPh	E	3	3	3	*Carpinus betulus*	·	·	·	·	·	+	+	·	·	+	·	II	0.14
H	Eua	3	3	0	*Campanula persicifolia*	·	·	·	·	+	·	·	·	·	·	·	I	0.04
G	E	2.5	3	4	*Cephalanthera damasonium*	·	·	·	·	·	·	+	·	·	·	·	I	0.04
mPh	Ec	3	3.5	4	*Cornus mas*	·	·	·	·	·	·	+	·	·	·	·	I	0.04
mPh	Eua	2.5	3	3	*Crataegus monogyna*	·	·	·	·	·	·	+	·	·	+	·	I	0.09
H	Eua	3	2	2	*Cruciata glabra*	·	·	·	·	+	·	·	+	·	·	·	I	0.09
H	Eua	4	3	0	*Dryopteris filix-mas*	+	+	+	+	+	+	+	+	+	+	+	V	1.00
G	Eua	3.5	3.5	4	*Erythronium dens-canis*	+	+	+	·	·	·	·	·	+	+	+	III	0.27

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H	Eua-M	3	0	3	*Epilobium montanum*	·	·	·	·	·	·	·	·	·	·	+	I	0.04
H	E	3.5	3	4	*Festuca altissima*	·	·	·	·	·	·	·	+	·	·	·	I	0.04
MPh	E	3	3	4	*Fraxinus excelsior*	·	·	·	·	·	+	·	·	·	·	·	I	0.04
Th	Cosm	3.5	3	3	*Geranium robertianum*	·	·	·	+	·	·	·	·	+	+	·	II	0.14
H	Cp	3	3	4	*Geum urbanum*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
l-nPh	Atl-M	3	3	3	*Hedera helix*	·	·	·	·	·	·	+	·	+	+	·	II	0.14
H	DB	2.5	3	4	*Helleborus purpurascens*	·	+	·	·	·	·	+	·	·	·	·	I	0.09
H	Cp	3	3	4	*Hepatica nobilis*	·	·	·	·	·	·	·	·	·	+	·	I	0.04
H	E	2	3	2	*Hieracium maculatum*	+	·	·	·	·	·	·	·	·	·	·	I	0.04
H	Eua	3	0	3	*Hieracium murorum*	·	·	·	+	+	·	·	·	·	·	·	I	0.09
H	Cp	2.5	3	2	*Hieracium umbellatum*	·	·	·	·	·	·	·	+	·	·	+	I	0.09
H	Eua	3	3	3	*Hypericum hirsutum*	·	+	·	·	·	·	·	·	·	·	·	I	0.04
H	Mp	3	4	3	*Lathyrus venetus*	·	+	·	·	·	·	·	·	+	·	·	I	0.09
G	Eua	3	3	3	*Lathyrus vernus*	·	·	·	·	·	·	+	·	+	+	·	II	0.14
H	E	2.5	2.5	2	*Luzula luzuloides*	+	·	·	+	+	+	·	+	·	·	+	III	0.27
Th	DB	2.5	3	3	*Melampyrum bihariense*	·	·	·	·	+	·	·	+	·	·	·	I	0.09
H	E	2,5	3	4	*Melica uniflora*	·	·	·	·	·	·	·	+	·	·	+	I	0.09
H	Ec	4	2	4	*Moehringia muscosa*	·	·	+	·	·	·	·	·	·	·	·	I	0.04
Th	Eua	2.5	3	3	*Moehringia trinervia*	·	·	·	·	·	·	·	·	+	·	+	I	0.09
H	E	3	3	0	*Mycelis muralis*	+	+	·	+	·	+	+	+	+	+	·	IV	0.36
G	Cp	3.5	3	5	*Phyllitis scolopendrium*	·	·	·	·	·	·	+	·	·	·	·	I	0.04
mPh	E	2	3	4	*Pyrus pyraster*	·	·	·	·	+	·	·	·	·	·	·	I	0.04
G	Eua-M	3.5	0	3	*Platanthera bifolia*	·	+	+	·	·	·	·	·	·	·	·	I	0.09
H	Eua	3	3	0	*Poa nemoralis*	·	·	·	·	·	·	·	·	·	·	+	I	0.04
G	P-Pan	3	3.5	4	*Polygonatum latifolium*	+	·	·	·	·	·	·	+	·	+	·	II	0.14
G	Eua	2	3	4	*Polygonatum odoratum*	·	+	+	·	·	·	+	+	·	·	+	III	0.23
MPh	Eua	3	2	2	*Populus tremula*	·	+	·	·	+	·	+	+	+	·	+	III	0.23
MPh	E	3	3	3	*Prunus avium*	·	·	·	+	+	·	+	·	+	·	·	II	0.18
G	E	3.5	3	4	*Scilla bifolia*	·	+	+	·	·	·	·	·	·	+	+	II	0.18
H	Eua	3.5	3	3	*Senecio nemorensis*	·	+	·	·	·	·	·	·	·	·	·	I	0.04
H	Eua	3.5	0	0	*Stachys sylvatica*	·	+	·	·	·	·	·	·	+	+	+	II	0.18
MPh	Ec	2.5	3	4	*Tilia platyphyllos*	·	·	·	·	+	·	·	·	·	·	·	I	0.04
MPh	Eua	4	3	3	*Ulmus glabra*	·	·	+	·	·	·	+	·	·	+	·	II	0.14
H	M	2.5	3.5	4	*Viola odorata*	·	·	·	·	·	·	+	+	·	·	·	I	0.09
H	Eua	3	3	3	*Viola reichenbachiana*	+	·	+	·	·	+	+	+	+	+	+	IV	0.36
					Quercetea pubescenti-petraeae													
nPh	Ec	2.5	3	0	*Cytisus nigricans*	+	·	·	·	·	·	·	+	·	·	·	I	0.09
Ch	DB	2.5	3	3	*Genista ovata*	·	·	·	+	+	·	·	+	·	·	·	II	0.14
mPh	E	2.5	3	3	*Ligustrum vulgare*	·	·	·	+	·	·	·	·	·	+	·	I	0.09
H	Eua	2.5	3	5	*Melittis melissophyllum*	·	·	·	·	·	·	+	·	·	·	+	I	0.09
MPh	E	2.5	3	0	*Quercus petraea*	·	·	·	+	+	·	+	+	·	·	+	III	0.23
MPh	E	2.5	3	4	*Sorbus torminalis*	·	·	+	·	·	·	+	·	·	·	·	I	0.09
G	M	3	3.5	4	*Tamus communis*	·	·	·	·	·	·	+	·	·	+	·	I	0.09
H	Eua	2	3	4	*Viola hirta*	·	+	·	·	·	·	·	·	·	+	·	I	0.09
H	Eua	2	4	4	*Vincetoxicum hirundinaria*	·	·	+	·	·	·	+	·	·	·	·	I	0.09
					Accompanying													
H	Eua	3	3	4	*Anthriscus sylvestris*	·	+	·	·	·	·	·	·	·	+	·	I	0.09
H	Eua	4	2	4	*Gentiana asclepiadea*	+	·	·	+	·	·	·	·	·	·	+	II	0.14
mPh	Mp	3	3	3	*Sambucus nigra*	+	1	·	·	·	·	·	·	·	+	+	II	0.59
nPh	Cp	0	2	1	*Vaccinium myrtillus*	·	·	·	+	+	·	·	+	·	·	·	II	0.14
H	Eua	3	0	0	*Veronica chamaedrys*	·	·	·	·	·	·	·	+	·	·	+	I	0.09

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; l-nPh - Climbing plants; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; T - Annual terophytes

F.e. - floristic elements; Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; End. carp. - Carpathian endemism; DB - Daco-Balkan; P-Pan - Ponto Pannonian; Cosm - Cosmopolitan; Atl-M - Atlantic-Mediterranean; Mp - Mediterano-Pontic, M - Mediterranean

U - humidity, T - temperature, R - the chemical reaction of the soil.

Species that occur in a single relevé: *Alliaria officinalis, Doronicum columnae, Doronicum austriacum, Eupatorium cannabinum, Impatiens noli-tangere, Prunela vulgaris, Ruscus aculeatus, Rubus sulcatus, Salix capraea, Solidago virgaurea, Urtica dioica, Verbascum phlomoides.*

Place and date of mapping: 1 - Valley of Huta (Bihor county) 28 August 2008; 2-3 - Valley of Finiş (Bihor county) 17 July 2008; 4 - Valley of Botfei (Arad county) 17 July 2009; 5 - Valley of Urviş (Arad county) 18 July 2009; 6–7 Valley of Clit (Arad county) 16 August 2009; 8 - Valley of Crişul Vărătec (Bihor county) 30 July 2008; 9 - Valley of Pontu - Pontu Stone (Bihor county) 18 July 2008; 10 - Valley of Ormanu (Bihor county) 18 July 2008; 11 - Valley of Şoimului (Bihor county) 20 August 2008.

Thermically one can observe the apparent dominance of micro-mesothermophilous ($T_{3-3.5}$=75.9%), followed by microthermophilous ($T_{2-2.5}$=12%) species. The heavy weight of micro-mesothermophilous is due to a rich regime of precipitation both in winter and in summer. Compared to the chemical reaction of the soil most species are weakly acid-neutrophyle (U_4=37%) and acid-neutrophyle (U_3=37%). This demonstrates the presence of weak acid soils of the eutricambosol type

in the phytocoenoses of the association *Festuco drymejae-Fagetum* Morariu et al. 1968.

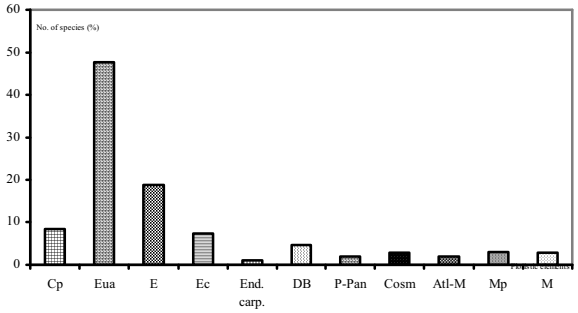

Figure 3. Spectrum of floristic elements of the association *Festuco drymejae-Fagetum* Morariu et al. 1968, where: Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; End. carp. - Carpathian endemism; DB - Daco-Balkan; P-Pan - Ponto Pannonian; Cosm - Cosmopolitan; Atl-M - Atlantic-Mediterranean; Mp - Mediterano-Pontic, M – Mediterranean.

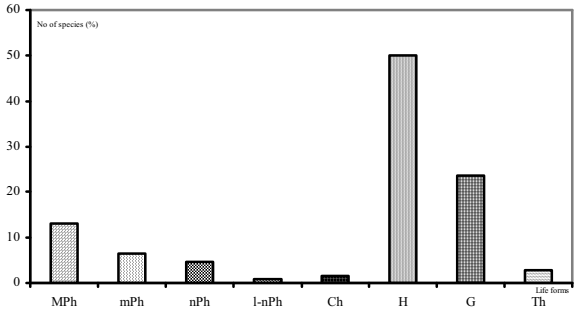

Figure 4. The life forms spectrum of association *Festuco drymejae-Fagetum* Morariu et al. 1968, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; l-nPh - Climbing plants; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; T - Annual terophytes.

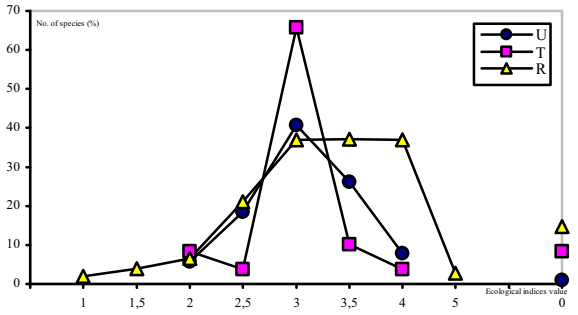

Figure 5. Diagram of ecological indices for the association *Festuco drymejae-Fagetum* Morariu et al. 1968, where: U - humidity, T - temperature, R - the chemical reaction of the soil.

Association ***Luzulo albidae-Fagetum sylvaticae*** Zólyomi 1955

The phytocoenoses of this association have been identified in Codru-Moma Mountains in the following 7 localities namely: Sasului Valley (Hăşmaş village), Clit Valley (Clit village), Vălaielor Brook (Şoim village), Summit of Măgura (Şoim village), Bălăteasa Peak (Şoim village), Tărcăiţei Valley (Tărcaia village).

The association (Fig. 6) can be found on slopes with different inclination, between 20° and 30°, at altitudes of 600-1050 m. The consistency of forest stands is usually between 80% and 100%. The coverage of herbaceous layer varies between 10% and 90%. This association can be found mainly on an acidic substrate, crystalline schists, on brown acid forest soils.

Figure 6. Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 Valley Clit (Clit village - Arad County).

Coenotaxonomically the association falls as follows:

Class ***QUERCO-FAGETEA*** Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi 1996;

Order ***Fagetalia sylvaticae*** Pawlowscki in Pawlowscki et al. 1928;

Alliance ***Symphyto cordati-Fagion*** Vida 1963;

Suballiance ***Calamagrostio-Fagenion*** Boşcaiu et al. 1982;

Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955.

From the species characteristic of alliance, order and class we mention: *Calamagrostis arundinacea, Deschampsia flexuosa, Hieracium transsilvanicum, Luzula luzuloides, Pteridium aquilinum, Carex digitata, Cardamine bulbifera, Rubus hirtus, Anemone nemorosa, Dryopteris filix-mas, Viola reichenbachiana.*

The floristic inventory of European beech forests with *Luzula luzuloides* totals 74 species (Table 2).

Analyzing the floristic elements (Fig. 7), one can observe the predominance of the Eurasian (Eua=46%), followed by European (E=25.4%) and Circumpolar (Cp=7.9%). From the euroasian species that have the highest share we mention: *Rubus hirtus, Carex pilosa, Lamium galeobdolon, Betula pendula*. One can observe the influence of European and Eurasian species, but the Circumpolar species too from tundra and silvotundra have a fairly heavy weight.

The spectrum of the life forms (Fig. 8), shows the numerical predominance of hemicryptophytes (H=50.8%), followed by geophytes (G=26.9%) and megaphanerophytes (MPh=7.8%). From the hemicryptophyte species that have the highest share we mention: *Luzula luzuloides, Carex digitata, Salvia glutinosa*. The large share of hemicryptophyte species suggests the presence of moderate to temperate climates where the grass vegetation abounds typical of pastures.

The spectrum of ecological indices (Fig. 9) shows that most species of the association are mezophyles in terms of humidity ($U_{3-3.5}$=69.9%), followed by xero-mezophyles ($U_{2-2.5}$=22.3%). One can observe the large share of mezophyle species belonging to the humid climate from which we mention: *Fagus sylvatica,*

Table 2. Association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 in Codru-Moma Mountains.

L.f.	F.e.	U	T	S.r.	Number	1	2	3	4	5	6	7	K	ADm
					Altitude (m.s.m.)	1050	800	850	850	830	900	600		
					Exposition	N	SV	SE	N	NV	NV	N		
					Slope (degree) (º)	25	20	25	20	20	30	20		
					Hight of the trees (m)	22	18	28	27	24	28	24		
					Consistency of tree layer	0.9	1	0.9	1	0.9	0.8	0.9		
					The grass layer (%)	35	20	10	55	50	15	25		
					Area (m²)	400	400	400	400	400	400	400		
MPh	E	3	3	0	As. *Fagus sylvatica*	5	5	5	5	5	4	5	V	83.93
H	E	2.5	2.5	2	As. *Luzula luzuloides*	+	1	1	1	+	1	1	V	3.71
					Calamagrostio-Fagenion, Symphyto cordati-Fagion									
MPh	Eua	3.5	3	3	*Acer pseudoplatanus*	+	·	·	·	+	·	·	II	0.14
H	Eua	2.5	3	2	*Calamagrostis arundinacea*	+	·	·	·	·	+	·	II	0.14
H	Cp	2	0	1	*Deschampsia flexuosa*	+	·	+	·	·	·	·	II	0.14
H	DB	3.5	2	3	*Pulmonaria rubra*	·	+	·	·	·	·	·	I	0.07
G	Cosm	3	3	0	*Pteridium aquilinum*	+	·	·	·	+	+	+	III	0.29
					Fagetalia sylvaticae									
H	Eua	3.5	3	4	*Asarum europaeum*	·	·	·	·	·	·	+	I	0.07
G	Ec	3.5	3.5	4	*Arum maculatum*	·	·	·	·	·	·	+	I	0.07
H	E	3	3	3	*Carex digitata*	+	·	+	·	+	·	·	III	0.21
H	E	3.5	3	4	*Carex sylvatica*	·	+	·	·	·	·	·	I	0.07
H	Eua	2.5	3	3	*Carex pilosa*	·	+	·	+	+	·	+	III	0.29
G	Ec	3	3	4	*Cardamine bulbifera*	·	·	+	3	·	+	1	III	6.21
G	End. carp.	4	2.5	4	*Cardamine glanduligera*	·	·	·	+	+	·	+	III	0.21
G	Eua	3.5	3	4	*Circaea lutetiana*	·	+	·	·	·	·	+	II	0.14
G	Eua	3	3	0	*Coryalis solida*	·	·	·	·	·	·	+	I	0.07
G	Ec	3	3	0	*Corydalis cava*	·	·	·	·	·	·	+	I	0.07
Ch	E	3	3.5	4	*Euphorbia amygdaloides*	·	+	·	·	+	·	·	II	0.14
H	E	4	2	3	*Festuca drymeja*	·	+	·	+	+	+	·	III	0.29
G	E	3.5	3	4	*Galanthus nivalis*	·	·	·	+	+	·	·	II	0.14
G	Eua	3	3	3	*Galium odoratum*	+	+	·	+	+	·	+	IV	0.36
H	Eua	3	3.5	3	*Isopyrum thalictroides*	·	·	·	+	·	·	·	I	0.07
H	Eua	3	0	4	*Lamium galeobdolon*	·	+	+	+	+	·	+	IV	0.36
G	Eua	3.5	3	4	*Mercurialis perennis*	·	·	·	+	·	·	+	II	0.14
G	Cp	4	3	3	*Oxalis acetosella*	+	+	·	·	·	·	·	II	0.14
nPh	Eua	3	2.5	3	*Rubus hirtus*	1	+	·	+	+	+	·	IV	1.00
nPh	Cp	3	3	3	*Rubus idaeus*	+	·	·	·	·	+	·	II	0.14
H	Eua	3.5	3	4	*Salvia glutinosa*	+	+	·	·	·	·	+	III	0.21
H	Eua	3.5	3	4	*Sanicula europaea*	·	·	·	·	+	·	·	I	0.07
H	Eua	3	3	3	*Symphytum tuberosum*	·	·	·	·	+	·	·	I	0.07
H	Eua	3.5	3	0	*Scrophularia nodosa*	+	·	·	·	·	·	·	I	0.07
					Querco-Fagetea									
G	Cp	3.5	4	0	*Anemone nemorosa*	·	·	·	+	3	·	1	III	6.14
G	Eua	3.5	3	4	*Anemone ranunculoides*	·	·	·	·	·	·	+	I	0.07
H	Ec	3	2.5	3.5	*Aposeris foetida*	·	·	·	·	+	·	·	I	0.07
H	Eua	3	2	2	*Betula pendula*	2	·	·	·	+	+	·	III	2.64
mPh	Eua	2.5	3	3	*Crataegus monogyna*	·	·	·	·	·	+	·	I	0.07
H	Eua	3	2	2	*Cruciata glabra*	+	+	·	·	+	·	·	III	0.21
H	Eua	4	3	0	*Dryopteris filix-mas*	+	·	·	+	+	+	+	IV	0.36
G	Eua	3.5	3.5	4	*Erythronium dens-canis*	·	·	·	+	·	·	·	I	0.07
H	E	2.5	3	4	*Euonymus verucosus*	·	·	·	·	·	+	·	I	0.07
G	Eua	2.5	3	3	*Galium schultesii*	·	·	·	·	·	·	+	I	0.07
Th	Cosm	3.5	3	3	*Geranium robertianum*	+	+	·	+	+	·	+	IV	0.36
H	Mp	2.5	3	4	*Glechoma hirsuta*	·	·	·	+	·	·	·	I	0.07
H	Eua	3	0	3	*Hieracium murorum*	·	·	+	·	·	·	·	I	0.07
H	E	3	2	2.5	*Hieracium transsilvanicum*	·	·	·	·	·	+	·	I	0.07
G	Eua	3	3	3	*Lathyrus vernus*	·	+	·	·	·	·	+	II	0.14
H	Mp	3	4	3	*Lathyrus venetus*	·	+	·	·	·	·	·	I	0.07
H-G	Ec-M	4	3	4	*Lunaria rediviva*	·	+	·	·	·	·	·	I	0.07
H	E	3	3	0	*Mycelis muralis*	+	+	+	·	·	·	+	III	0.14
Th	Eua	2.5	3	3	*Moehringia trinervia*	+	+	·	·	+	·	+	III	0.29
H	Eua	3	3	0	*Poa nemoralis*	·	·	·	·	·	+	·	I	0.07
G	P-Pan	3	3.5	4	*Polygonatum latifolium*	·	+	·	+	·	·	+	III	0.21
H	E	3.5	3.5	3.5	*Polystichum aculeatum*	·	+	·	·	·	·	·	I	0.07
MPh	E	3	3	3	*Prunus avium*	·	+	·	·	·	·	·	I	0.07
MPh	E	2	3	4	*Pyrus pyraster*	+	·	·	·	·	·	·	I	0.07
G	E	3.5	3	4	*Scilla bifolia*	·	·	·	+	·	·	·	I	0.07
H	Eua	3.5	0	0	*Stachys sylvatica*	·	+	·	·	·	·	·	I	0.07
H	Eua	3	3	3.5	*Viola reichenbachiana*	·	+	·	+	·	+	·	III	0.21
					Quercetea pubescenti-petraeae									
H	Eua	2.5	3	5	*Melittis melissophyllum*	+	·	·	·	·	+	·	II	0.14
MPh	E	2.5	3	0	*Quercus petraea*	+	·	·	+	·	·	·	II	0.14
mPh	E	2.5	3	4	*Sorbus torminalis*	+	·	·	·	+	·	·	II	0.14
					Accompanying									
mPh	Mp	3	3	3	*Sambucus nigra*	+	+	·	·	·	+	+	III	0.57
nPh	Cp	0	2	1	*Vaccinium myrtillus*	+	·	·	+	·	+	·	III	0.21

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; H - Hemicryptophytes; G - Geophytes; T - Annual terophytes; Ch - Chamephytes
F.e. - floristic elements; Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; End. carp. - Carpathian endemism; DB - Daco-Balkan; P-Pan - Ponto Pannonian; Mp - Mediterano-Pontic, Cosm - Cosmopolitan; M - Mediterranean.
U - humidity, T - temperature, R - the chemical reaction of the soil.
Species that occur in a single relevé: *Alliaria officinalis, Clematis vitalba, Crocus heuffelianus, Dryopteris carthusiana, Gentiana asclepiadea, Impatiens noli-tangere, Sambucus racemosa, Sorbus aucuparia, Urtica dioica, Verbascum phlomoides.*
Place and date of mapping: 1 - In the spring valley of Sasului (Arad county) 18 August 2009; 2-3 Valley of Clit (Arad county) 16 August 2009; 4 - Brook of Vălaielor - Summit of Bălăteasa (Bihor county) 28 August 2008; 5 - Summit of Măgura (Bihor county) 28 August 2008; 6 - Peak of Bălăteasa 20 August 2008; 7 - Valley of Tărcăiţa (Bihor county) 14 August 2008.

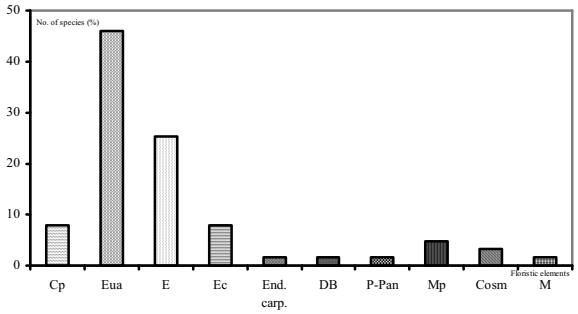

Figure 7. Spectrum of floristic elements of the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; End. carp. - Carpathian endemism; DB - Daco-Balkan; P-Pan - Ponto Pannonian; Mp - Mediterano-Pontic, Cosm - Cosmopolitan; M - Mediterranean.

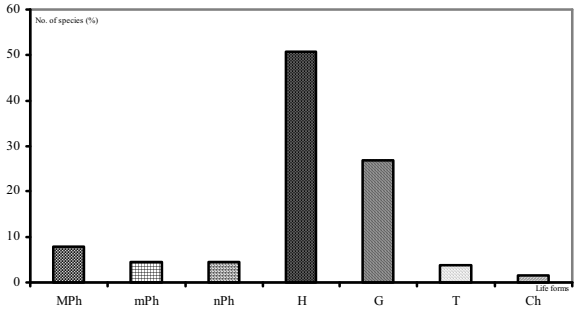

Figure 8. The spectrum of life forms in the association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; H - Hemicryptophytes; G - Geophytes; T - Annual terophytes; Ch - Chamephytes.

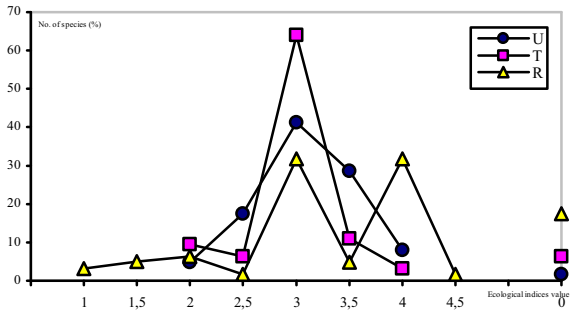

Figure 9. Diagram of ecological indices for association *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955, where: U - humidity, T - temperature, R - the chemical reaction of the soil.

Pteridium aquilinum, Cardamine bulbifera, Galium odoratum, Anemone nemorosa. If analyzed thermically, we can see the dominance of micro-mesothermophilous ($T_{3-3.5}$=74.9%), followed by microthermophilous ($T_{2-2.5}$=15.7%) elements. Compared to the chemical reaction of the soil most species are acid-neutrophilous ($U_{3-3.5}$=36.5%) and weak acid-neutrophilous ($U_{4-4.5}$=34%). The crystalline schist substrate type on which the phytocoenoses of *Fagus sylvatica* with *Luzula luzuloides* develops, determines the presence of a large percentage of acid neutrophilous species.

DISCUSSIONS

The phytocoenoses investigated by Ana Paucă in pure European beech stands from Codru-Moma Mountains were placed in a group of associations called ***Fagetum carpaticum*** (Carpathian beech stand). This group of associations has been placed from a cenotaxonomic point of view in that period in the class ***Querco-Fagetea*** Br.-Bl. Et Vlienger 1937, the order ***Fagetalia silvaticae*** (Paw. 1928 n.n.) Tx. 1936, the alliance ***Fagion silvaticae*** (Paw. 1928 n.n.) Tx. 1937 [11].

The author of the study conducted a total of 14 phytocoenologic relevées during 1935-1939, in pure beech forest stands from Codru-Moma Mountains, in the following localities: 16 June 1935 Bălăteasa Peak, Huta Valley 18 June - 26 July 1935, Pietroasa Valley-Moneasa 13 July 1935, South of Glade Brătcoaia 09 April 1936, West of Glade Tinoasa 09 April 1936, 10 April 1936 Bear Valley, Briheni 09 June 1937, Peak Bujorului-Dumbrăviţa 16 July 1937, Groşeni 25 July 1937, Zugăului Valley 03 May 1939 [11].

Of the 14 phytocoenological relevées made, 11 relevées were made on limestone bedrock and 3 relevées on siliceous rocks (granite) [11]. Also Paucă (1941) [11] found a better development of pure beech stands (*Fagus sylvatica*) on limestone substrate. She also states that the pure beech forest stands (*Fagus sylvatica*) are rare in Codru-Moma Mountains, these stands forming portions of old secular forest [11]. The pure European beech stands are located on the shady, moist valleys, forming the middle of the forests and toward the edge beech (*Fagus sylvatica*) is mixed with hornbeam (*Carpinus betulus*) [11].

Compared with the description performed by Paucă (1941) [11], we can observe differences of the coenotaxonomic classification of associations belonging to pure European beech stands in Codru-Moma Mountains. In the present study the two investigated associations, namely: *Festuco drymejae-Fagetum* Morariu et al. 1968 and *Luzulo albidae-Fagetum sylvaticae* Zólyomi 1955 are classified in coenotaxonomic terms in the class ***Querco-Fagetea*** Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi 1996, the order ***Fagetalia sylvaticae*** Pawlowscki in Pawlowscki et al. 1928, the alliance ***Symphyto cordati-Fagion*** Vida 1963, the ***Symphyto-Fagenion*** Boşcaiu et al. 1982 and ***Calamagrostio-Fagenion*** Boşcaiu et al. 1982 suballiances.

The presence of pure european beech in the

limestone and acid bedrock can be found even today, except that the pure european beech with *Festuca drymeja* on limestone bedrock and pure european beech with *Luzula luzuloides* on acidic rocks have the heaviest weight.

We can observe that pure european beech forests are currently occupying small areas in Codru-Moma Mountains, ancient forests mentioned by Ana Paucă disappeared with increasing accessibility and continuous and uncontrolled exploitation of forests in the area.

We found these European beech stands in shady valleys and on the northern shady slopes.

By studying the flora elements one can see that in these two associations the euroasian species have the highest share, which illustrates that the studied area belongs to the vast euroasian region. From the euroasian species best represented in the floristic composition of the two associations are: *Galium odoratum, Lamium galeobdolon, Mercurialis perennis, Rubus hirtus, Dryopteris filix-mas*.

Phytocoenoses varieties belonging to association *Festuco drymejae-Fagetum* vegetate in resorts nearby to the associations *Carpino-Fagetum* phytocoenoses, the later growing on the lower third of slopes throughout valleys and streams as against associations *Festuco drymejae-Fagetum* phytocoenoses which are growing in the upper third of mountains sloped reaching their higher peaks.

Analysing the previously described virgin European beech forests by Paucă (1941) [11] on the basis of associations chart containing 14 relevées, one notice the following: *Symphytum cordarum* European beech forests have a 36% share (5 relevées), *Luzula luzuloides* European beech forest have a 21% share (3 relevées), *Festuca drymeja* European beech forests have a 14% share (2 relevées), while for a number of 4 relevées none of the above mentioned association differential species occurs.

As for the arboretum described by us, out of the total of 18 relevées, the *Festuca drymeja* European beech forests represents a share of 61% (11 relevées) while the *Luzula luzuloides* European beech forest have a share of 39% share (7 relevées).

Symphytum cordarum European beech forests, occupying formations with calcareous substratum, did not make the object of our field research, thus it is premature to make an assessment of their syndinamics over the last 70 years.

The analysis of life forms revealed the predominance of the hemicryptophytes, which shows the studied area belongs to temperate climate. The analysis of ecological indices for the associations found in pure European beech forests in Codru-Moma highlights in terms of humidity the highest share of mezophyle species, in terms of temperature that of micro-mezotherm species and in terms of soil reaction the predominant species are those that are slightly acid-neutrophyle.

The associations described are stable in terms of dynamics and ecological balance, the dominant species of tree layer and those of the grass layer do not exclude one another, they live together.

The pure european beech stands of Codru-Moma Mountains have suffered in the past 70 years since the first description made by Paucă (1941) [11], an anthropogenic influence due to the aggressive timber exploitation by traders, the abusive and uncontrolled cuttings by some owners.

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