

## RESEARCH ON THE ASSOCIATION *CARPINO – FAGETUM* PAUCĂ 1941 ON ORADEA HILLS

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### **Abstract**

The phytocoenoses of Association *Carpino-Fagetum*, stationed on the northern slopes, and the steep, shady and moist creeks of Oradea Hills were surveyed by us in terms of floristic composition along with the classification of 72 species identified in the corresponding cenotaxa, sub-alliance, alliance, order and class.

In order to run a thorough survey on the association, 5 tables and 4 graphs were designed representing the spectrum of life forms, floristic elements spectrum, karyotype spectrum and the ecological indices chart.

**Key words:** phytocoenosis, association, life forms, floristic elements.

### **INTRODUCTION**

Dacian beech and hornbeam forests are widespread in Romania on all peri- and intra-Charpathian hills as well as on the lower part of Carpathians within the nemoral floor. They spread sporadically in Oradea Hills, being identified by the author, Morar (Burescu) (2012), Sabau, Morar (Burescu) (2012), in stations at altitudes of 180-220m, on slopes of small and medium gradient (10-25°), on clay rocks, diorite sands, and on deep soils i.e. eutricambosols, luvisoils, hydric-balanced, weak acid, eubasic and eutrophic soils.

### **MATERIAL AND METHODS**

During our research on the Association *Carpino-Fagetum* phytocoenoses we employed the Central European school research methods developed on the basis of methods principles elaborated by Braun - Blanquet (1964) and adapted by Borza (1934), Borza, Boșcaiu (1965) to our country vegetation features. Surveying was conducted during the trips made on the field from April until August; floristic sampling was made on floristically homogeneous surfaces selected within the afforested areas specific for beech and hornbeam forests, their size being of 400 m<sup>2</sup>. Quantitative assessment of the participation of each species was done using the abundance-dominance index according to the evaluation system of Braun-Blanquet and Pavillard (1928).

## RESULTS AND DISCUSSION

Association table contains information about the species entering the floristic composition of plants populations that make up phytocoenosis, life form, floristic element, ecological index, karyotype, sequence number of the survey, altitude, exposition, consistency, height and diameter of trees, slope, surface, coverage differentiated by vegetation layers, place and time of surveying (Table 1). At the end of the table the species constant (K) was computed. In order to complete the research we plotted the distribution of life forms, floristic elements, ecological indices and karyotype. Classification of species in the association table to the corresponding cenotaxa units i.e. sub-alliance, alliance, order, class was made in accordance with the ecological and flora systems of the following authors: Borza, Boscaiu (1965), Mucina (1997), Pott (1995), Borhidi (1996, 2003), Coldea (1997), Sanda et al. (2008). The phytocoenoses of the Association *Carpino-Fagetum* present as characteristics and representative species the following ones: *Carpinus betulus* (abundance-dominance ratio 1-3), and *Fagus sylvatica* (abundance-dominance ratio 1-4) which are co-dominant. Besides the two species of wood afore mentioned the forest' tree layer consists also of: *Acer platanoides* (Norway maple), *Acer campestre* (field maple), *Quercus petraea* (sessile oak), *Quercus robur* (oak), *Quercus cerris* (cerris), *Sorbus torminalis* (wild service tree), *Tilia tomentosa* (silver lime), *Prunus avium* (cherry). Tree crowning indicates a consistency ranging between 0.5-0.7, and a soil coverage ranging between 50% to 70%, a height of 19-27 m, the diameter of the trunks ranging between 35-60 cm, and the age of the trees ranging between 80-100 years (Table 1).

The shrub layer showing a variable development depending on the stand coverage consists of the following: *Cornus mas*, *Sambucus nigra*, *Corylus avellana*, *Evonymus europaeus*, *Crataegus monogyna*. Herbaceous layer is well emphasised with coverage ranging between 70-90%. Floristic composition of beech and hornbeam forests of Oradea Hills is rich and varied totalling 72 species specific for the sub-alliance *Lathyro hallersteinii* – *Carpinenion* as follows: *Aposeris foetida*, *Dactylis polygama*, *Potentilla micrantha*, *Arum maculatum*, *Ranunculus auricomus*, *Stellaria holostea*; alliance *Sympyto cordati-Fagion*: *Veronica officinalis*, *Dryopteris filix-mas*, *Festuca drymeja*, *Circaeae lutetiana*, *Stachys sylvatica*, *Geranium robertianum*, *Acer platanoides*; specific to the order *Fagetalia sylvaticae* as follow: *Allium ursinum*, *Asarum europaeum*, *Carex sylvatica*, *Euphorbia amygdaloides*, *Galium odoratum*, *Mercurialis perennis*, *Pulmonaria officinalis*, *Rubus hirtus*, *Sanicula europaea*; to the class *Querco-Fagetea*: as follows: *Crataegus monogyna*, *Viola reichenbachiana*, *Cornus mas*, *Cruciata glabra*, *Galium schultesii*, *Geum urbanum*, *Lygustrum vulgare*,

*Quercus petraea*, *Aegopodium podagraria*, *Sambucus nigra*, *Corylus avellana*, *Acer campestre*, *Evonymus europaeus*, *Anemona nemorosa*, *Melica uniflora*, *Hedera helix*, *Cardamine bulbifera*, *Carex digitata*; transgress in the class: *Quercetea pubescenti-petraeae* as follows: *Melittis melissophyllum*, *Polygonatum odoratum*, *Lathyrus niger*, *Vinca minor*, *Quercus cerris*, *Tilia tomentosa*, *Lathyrus venetus* (Table 1).

Table 1  
Association *Carpino-Fagetum* Paucă 1941

L.f.	F.e.	H	T	R	2n	Species/ surveys no	1	2	3	4	5	6	K
						Altitude (m)	200	220	190	170	180	200	
						Exposition	V	S	E	V	N	E	
						Slope (°)	15	20	15	10	15	25	
						Trees height	25	22	20	25	27	19	
						Trunks diameter	45	50	35	40	60	40	
						Trees crowing	0.6	0.6	0.5	0.7	0.4	0.3	
						Ground-cover herbs	80	85	90	90	70	80	
						Area (m²)	400	400	400	400	400	400	
Characteristic species of Association													
MPh	E	3	3	0	D	<i>Fagus sylvatica</i>	2	4	1	1	4	2	V
MPh	E	3	3	3	P	<i>Carpinus betulus</i>	3	+	3	4	1	3	V
<i>Lathyro hallersteinii-Carpinetion</i>													
H	Ec	3	2.5	3	D	<i>Aposperis foetida</i>	+	-	-	+	+	+	IV
H	Ec	2.5	3	3	D	<i>Dactylis polygama</i>	-	+	-	+	+	+	IV
H	M	2.5	3.5	3	D	<i>Potentilla micrantha</i>	+	-	+	+	+	-	IV
G	E	3.5	3.5	4	P	<i>Arum maculatum</i>	-	-	-	+	+	-	II
H	Eua	3.5	3	3	DP	<i>Ranunculus auricomus</i>	-	+	-	-	-	+	II
H	Eua	3	3	0	D	<i>Stellaria holostea</i>	+	-	-	-	+	-	II
<i>Sympeto cordati-Fagion</i>													
Ch	Eua	2	2	2	DP	<i>Veronica officinalis</i>	+	+	-	-	+	+	IV
H	Cosm	4	3	0	P	<i>Dryopteris filix-mas</i>	+	-	+	+	-	+	IV
G	Carp-B	4	2	3	D	<i>Festuca drymeja</i>	-	1	-	2	-	+	III
G	Eua	3.5	3	4	D	<i>Ciraea lutetiana</i>	-	-	-	+	+	+	III
H	Eua	3.5	0	0	P	<i>Staphys sylvatica</i>	-	-	+	-	-	+	II
Th	Cosm	3.5	3	3	P	<i>Geranium robertianum</i>	-	-	-	+	-	+	II
MPh	Eua	3	3	3	DP	<i>Acer platanoides</i>	-	+	-	-	+	-	II
H	Eua	3	3	0	D	<i>Campanula persicifolia</i>	-	+	-	+	-	-	II
<i>Fagetalia sylvatica</i>													
G	E	3.5	2.5	0	D	<i>Allium ursinum</i>	2	4	5	-	-	+	IV
H	Eua	3.5	3	4	DP	<i>Ascarum europaeum</i>	-	-	+	+	+	+	IV
H	E	3.5	3	4	P	<i>Carex sylvatica</i>	+	-	-	3	+	+	IV
Ch	E	3	3.5	4	D	<i>Euphorbia amygdaloides</i>	+	+	+	-	-	+	IV
G	Eua	3	3	3	P	<i>Galium odoratum</i>	+	+	-	+	+	+	IV
H	E	3.5	3	4	P	<i>Mercurialis perennis</i>	-	-	+	+	+	+	IV
H	E	3.5	3	3	D	<i>Pulmonaria officinalis</i>	+	+	-	+	+	-	IV
nPh	E	3	2.5	3	D	<i>Rubus hirtus</i>	+	+	+	-	-	+	IV
H	Atl-M	3.5	3	4	D	<i>Sanicula europaea</i>	+	+	-	+	-	+	IV
G	E	3	3	0	P	<i>Corydalis solida</i>	3	-	-	+	+	-	III
H	Eua	3	0	4	D	<i>Lamium galeobdolon</i>	-	+	-	-	+	1	III
H	Eua	3	3	3	D	<i>Lathyrus vernus</i>	+	-	-	+	+	-	III
H	Eua	3.5	3	4	D	<i>Salvia glutinosa</i>	+	-	-	+	-	-	II
<i>Querco-Fagetea</i>													
mPh	E	2.5	3	3	D	<i>Crataegus monogyna</i>	+	+	1	+	+	-	V
H	Eua	3	3	3	P	<i>Viola reichenbachiana</i>	+	+	+	+	+	+	V
mPh	Mp	2	3.5	4	D	<i>Cornus mas</i>	+	+	3	-	-	+	IV
H	Eua	3	2	2	DP	<i>Crucata glabra</i>	+	+	-	+	-	+	IV
G	Ec	2.5	3	3	P	<i>Galium schultesii</i>	+	-	-	+	+	+	IV
H	Eua	3	3	4	D	<i>Geum urbanum</i>	+	+	-	-	+	+	IV
MPh	E	2.5	3	3	P	<i>Lygustrium vulgare</i>	+	+	+	-	+	-	IV
MPh	E	2.5	3	0	D	<i>Quercus petraea ssp. petraea</i>	-	+	1	2	+	-	IV
H	Eua	3.5	3	3	DP	<i>Aegopodium podagraria</i>	+	+	-	+	+	-	IV
MPh	E	3	3	3	P	<i>Sambucus nigra</i>	+	+	+	-	+	-	IV
mPh	E	3	3	3	D	<i>Corylus avellana</i>	+	+	-	-	+	-	III
MPh	E	2.5	3	3	D	<i>Acer campestre</i>	-	-	+	-	+	+	III
G	E	3.5	4	0	DP	<i>Anemone nemorosa</i>	+	-	+	-	+	-	III
mPh	E	3	3	3	P	<i>Evonymus europaeus</i>	+	-	+	-	-	+	III
H	E	2.5	3	4	D	<i>Melica uniflora</i>	+	-	+	-	-	+	III
nPh	Atl-M	3	3	3	P	<i>Hedera helix</i>	+	-	+	-	1	-	III
H	Eua	3	3	0	DP	<i>Poa nemoralis</i>	-	-	+	+	+	-	III
G	Ec	3	3	4	P	<i>Cardamine bulbifera</i>	+	-	+	-	-	+	III
H	E	3	3	3	P	<i>Carex digitata</i>	-	+	-	+	-	-	II
H	E	3	3	0	D	<i>Mycelis muralis</i>	-	+	-	+	-	-	II
MPh	E	3.5	3	0	D	<i>Quercus robur</i>	-	-	-	+	-	+	II
G	E	3.5	3	4	P	<i>Scilla bifolia</i>	+	+	-	-	-	-	II
MPh	E	2.5	3	4	D	<i>Sorbus terminalis</i>	+	+	-	+	-	-	II
H	E	3.5	0	0	P	<i>Ajuga reptans</i>	-	-	+	-	-	+	II
Ch	Eua	2.5	3	2	D	<i>Genista tinctoria</i>	-	-	-	+	+	-	II

G	E	2.5	3	3	P	<i>Convallaria majalis</i>	-	-	+	-	+	-	II
MPh E		3	3	3	DP	<i>Prunus avium</i>	-	-	-	+	-	+	II
<b><i>Quercetea pubescenti-petraeae</i></b>													
H	Ec	2.5	3	5	CN	<i>Melitis melissophyllum</i>	+	+	+	+	-	+	V
G	Eua	2	3	4	D	<i>Polygonatum odoratum</i>	-	+	+	+	+	-	IV
H	Ec	2.5	3	3	D	<i>Lathyrus niger</i>	+	+	+	+	-	-	IV
H	Cosm	3	3	4	P	<i>Urtica dioica</i>	+	+	+	-	-	+	IV
Ch	M	3	3	3	D	<i>Vinca minor</i>	+	+	+	-	-	-	IV
MPh Mp		2	3.5	3	D	<i>Quercus cerris</i>	+	-	1	-	-	+	III
H	Mp	3	4	3	D	<i>Lathyrus venetus</i>	-	+	-	+	+	-	III
H	Eua	3	2.5	0	P	<i>Fragaria vesca</i>	-	-	-	+	+	+	III
MPh B		2.5	3.5	3	D	<i>Tilia tomentosa</i>	-	-	2	+	-	-	II
G	Atl-M	3	3.5	4	P	<i>Tamus communis</i>	-	+	-	+	-	-	II
mPh Ec		3	3	4	D	<i>Cornus sanguinea</i>	+	-	-	+	-	-	II
<b><i>Variae syntaxa</i></b>													
H	Eua	3.5	3	3	P	<i>Ranunculus ficaria</i>	1	+	1	-	+	-	IV
G	Ec	3	3.5	3	D	<i>Isopyrum thalictroides</i>	+	-	-	+	+	-	III
G	Ec	2	3	3	P	<i>Gagea pratensis</i>	+	-	-	-	+	+	III
Th	Cp	3	3	2	D	<i>Galium aparine</i>	-	-	+	-	+	+	III
H	Cp	2.5	3	3	D	<i>Solidago virgaurea</i>	-	-	+	-	-	+	II

The spectrum of life forms (Table 2, Figure 1) is dominated by hemi-cryptophytes species (44.4%) indicating the belonging of the surveyed area to temperate climate regions, followed by phanerophytes (26.4%) inducing the association's physiognomy and influences decisively the climatic nature of the relief. Geophila having a 20.8% share of all species make prevernal and vernal flora of beech and hornbeam (*Carpino - Fagetum*) forests, representing the synecological expression of the forests eco-systems during daylight. The chamaephytes (5.6%) colonize dry places and the gravel in the clearings of beech and hornbeam forests.

Table 2  
Distribution of life forms for the phytocoenoses of the Association *Carpino-Fagetum*

Life forms	MPh	mPh	nPh	H	G	Ch	Th
No. of species	12	5	2	32	15	4	2
%	16.67	6.94	2.78	44.44	20.83	5.56	2.78

where: H - hemicryptophytes; G - geophytes; Mph, mPh, nPh - phanerophytes; Ch - chamaephytes; Th - annual terophytes; I - nPh - climbing plants.

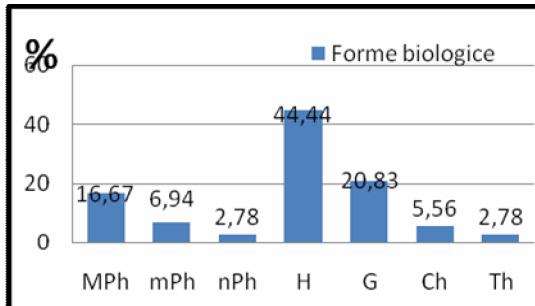


Fig. 1. Spectrum of life forms for the phytocoenoses of the Association *Carpino-Fagetum*  
where: H - hemicryptophytes; G - geophytes; Mph, mPh, nPh - phanerophytes; Ch - chamaephytes; Th - annual terophytes; I - nPh - climbing plants; Legend: *Forme biologice* – Life forms

The analysis of floristic elements (Table 3) shows the presence of ten species categories of different geographical origins and specific environmental requirements. The floristic elements spectrum (Table 3, Figure 2) is dominated by European species (36.1%) followed by Eurasian (29.2%) and the Central Europe ones (13.9%). The Southern, Mediterranean - Pontic, Atlantic-Mediterranean, and Balkan species cumulate altogether a share of 12.5%.

*Table 3*  
Distribution of floristic elements for the phytocoenoses of the Association  
*Carpino-Fagetum*

Floristic elements	E	Ec	M	Eua	Carp-B	Cosm	Atl-M	Mp	Cp	B
No. of species	26	10	2	21	1	3	3	3	2	1
%	36.11	13.89	2.78	29.17	1.39	4.17	4.17	4.17	2.78	1.39

where: Eua - Eurasian; E - European; Ec - Central European; M - Mediterranean; Atl-M - Atlantic-Mediterranean; Mp - Mediterranean-Pontic; B - Balkan; Cosm - Cosmopolitan, Carp-B - Carpathian-Balkan

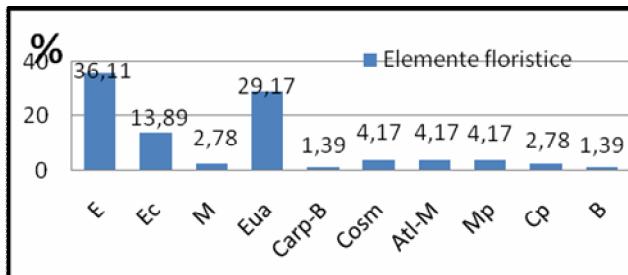


Fig. 2. Spectrum of floristic elements for the phytocoenoses of the Association  
*Carpino-Fagetum*

where: Eua - Eurasian; E - European; Ec - Central European; M - Mediterranean; Atl-M - Atlantic-Mediterranean; Mp - Mediterranean-Pontic; B - Balkan; Cosm - Cosmopolitan, Carp-B - Carpathian-Balkan; Legend: *Elemente floristice* – Floristic elements

The ecological indices chart (Table 4, Figure 3) with respect to humidity shows the dominance of mesophilic species (69.4%) highlighting the main behaviour of beech and hornbeam forests, followed well behind by xero-mesophile species (27.7%). In terms of climate temperature related preferences (Table 4, Figure 3), in the beech and hornbeam forests the micro-mesothermal plants (83.3%) dominate overwhelmingly, followed by the micro-mesotherm plants (9.7%) which colonize the high peaks, northern slopes, and the narrow, shady and cool valleys. Analysis of species by chemical reaction of the soil (Table 4, Figure 3) emphasizes the neutrophil acid (47.2%) and weak acid-neutrophil (26.3%) character of the soil induced to plants by the Oradea Hills' soils.

Moreover in the beech and hornbeam forests there are living a large number of plants showing a large tolerance to euroionic soil' chemical reaction with a share of 19.4%.

*Table 4*  
Distribution of ecologic indices for the phytocoenoses of the Association  
*Carpino-Fagetum*

Ecological indices	Classes values	1	1.5	2	2.5	3	3.5	4
H	No. of species	-	-	5	15	32	18	2
	%	-	-	6.94	20.83	44.44	25	2.78
T	No. of species	-	-	3	4	52	8	2
	%	-	-	4.17	5.56	72.22	11.11	2.78
R	No. of species	-	-	4	-	34	-	19
	%	-	-	5.56	-	47.22	-	26.39
Ecological indices	Classes values	4.5	5	5.5	6	0	Total species	
H	No. of species	-	-	-	-	-	72	
	%	-	-	-	-	-	100%	
T	No. of species	-	-	-	-	3	72	
	%	-	-	-	-	4.17	100%	
R	No. of species	-	1	-	-	14	72	
	%	-	1.39	-	-	19.44	100%	

where: H = humidity, T = temperature, R = chemical reaction of soil.

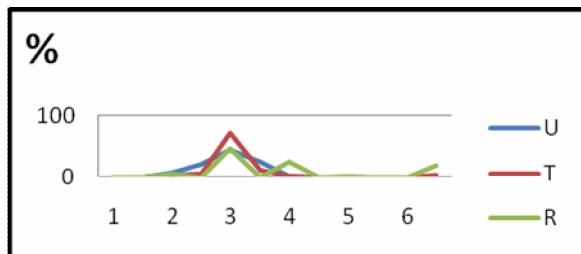


Fig. 3. Diagrammatic representation of ecological indices for the phytocoenoses of the Association *Carpino-Fagetum*

where: H = humidity, T = temperature, R = chemical reaction of soil.

In the Cariological spectrum (Table 5, Figure 4) the diploid species are dominant (51.4%), followed by polyploid (34.7%) and the diplo-polyploid species (12.5%). If diploid species are those embedding the genetic heritage required to the plants development in the future, the polyploid species demonstrate the anthropogenic pressure exerted on phytocoenoses association i.e. lumbering, grazing, soil erosion, landslides, fire, etc. Polyploidy induces a high colonization capacity to nude species which are easily adaptable to extreme environmental living conditions.

Table 5

Distribution of karyotypes for the phytocenoses of the Association *Carpino-Fagetum*

Karyotype (2n)	P	D	DP	CN
No.	25	37	9	1
%	34.72	51.39	12.5	1.39

where: P = polyploid, D = diploid, DP = diplo-polypliod, CN = unknown karyotype.

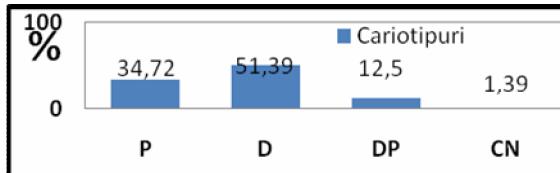


Fig. 4. Spectrum of karyotypes of the vascular plants for the phytocenoses of the Association *Carpino-Fagetum*

where: P = polyploid, D = diploid, DP = diplo-polypliod, CN = unknown karyotype; Legend: *Cariotipuri* – Karyotypes



Fig. 5. Phytocenoses of the Association *Carpino-Fagetum*, Oradea Hills

## CONCLUSIONS

1. The phytocenoses of the Association *Carpino - Fagetum* include in their floristic composition a total number of 72 species subordinated to the sub-alliance *Lathyrho hallersteinii-Carpinenion*, alliance *Symphyto cordati-Fagion*, order *Fagetalia sylvaticae* and the class *Querco-Fagetea*.

2. The study of life forms spectrum highlights the high percentage of hemi-cryptophytes (44.4%), followed by phanerophytes (26.4%), geophytes (20.8%) and chamaephytes (5.6%).
3. The study of floristic elements highlights the dominance of European species (36.1%), followed by Eurasian (29.2%), Central Europe (13.9%) and Southern Europe species (12.5%).
4. The study of ecological indices shows the mesophilic (69.4%), micro-mesothermal (83.3%), and the acid-neutrophil (47.2%) character of plant species forming the structure of phytocoenoses of Association *Carpino-Fagetum*.
5. From the ecological point of view, the phyrocenoses of the Association *Carpino-Fagetum* provides basic environmental services of nature in critical situations, containment of erosion, protection of the drainage basins, climate stability of Oradea Hills' relief.

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