CONTRIBUTIONS TO THE PHYTOCOENOLOGIC STUDY IN PURE EUROPEAN BEECH STAND FORESTS WITH *SYMPHYTUM CORDATUM* IN BIHOR COUNTY

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RESEARCH ARTICLE

Abstract
In the present study, a synthesis of the floristic diversity of pure beech stand forests with Symphytum cordatum from Bihor County is presented. The territory of Romania benefits from a great geomorphological and pedoclimatic diversity, favoring the development of a great floristic and phytocenological diversity of forest vegetation. Symphyto cordati-Fagetum Vida 1963, forest plant association is part of the forest phytotaxons with a more restricted distribution in our country, including a number of relict, endemic or rare species. The description of the Symphyto cordati-Fagetum Vida 1963 association from Bihor County was made by summing up 5 phytocoenological studies carried out in the Codru-Moma Mountains, Plopiş Mountains, Pădurea Craiului Mountains, the northern part of the Bihor Mountains and the upper of the Crişului Repede basin (the interfluve of Valea Iadei-Valea Drăganului), made in different periods of time. Presentation of the studied association was made by drawing up a synthetic table, selecting the relevèes carried out in different areas of Bihor County in certain periods of time.

Keywords: phytocoenoses, floristic composition, beech forests, relevèes, association
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INTRODUCTION

Phytocoenoses edified by *Fagus sylvatica* and *Symphytum cordatum*, forms pure zonal stands on limited territories in the Carpathian chain in our country. The phytocoenological study of the beech forests with *Symphytum cordatum* in Bihor County was done in the Codru Moma Mountains (Păşcuţ, 2012), Plopiş Mountains (Coldea, 1975), Pădurea Craiului Mountains (Groza, 2008), the northern part of the Bihor Mountains (Togor, 2016), the upper basin of Crişului Repede River (Iadei Valley-Drăganului Valley interfluve) (Pop, 2024).

In the last 25 years the *Symphyto cordati-Fagetum* Vida 1963 association has been studied in our country by several authors, from Piatra Craiului Massif (Mihăilescu, 2001), Gurghiului Valley (Sămărghiţan, 2005), Prahova Valley (Biţă, 2003), Moldova (Chifu et al., 2006), Cernei of Olteţ Basin (Răduţoiu, 2006), Luncavaţ River Basin (Niculescu, 2006), Bistriţei Basin (Aoncioaie, 2008), Stânişoara Mountains (Oprea & Sârbu, 2009), Orăştie River Basin (Vinţan, 2014), Bihor Mountains (Ursu, 2013), Meseş Mountains (Ştef, 2021), Semenic Mountains (Bojinescu, 2022).

These phytocoenoses occupy flat, gently sloping to steep lands, with deep, soft brown, pseudogleyic, sometimes slightly skeletal, moderately rich in nutrients, rich in humus, moist soils (Chifu et al., 2014).

The association includes pure and mixed beech forests with fir and spruce in the climax stage. These phytocoenoses are well individualized floristically and ecologically in relation to the beech stand forests of central and western Europe through a group of Carpatho-Balkan species such as *Symphytum cordatum*, *Dentaria glandulosa*, *Euphorbia carniolica*, *Hepatica transsilvanica*, *Primula elatior* ssp. *leucophylla*, *Pulmonaria rubra*.

MATERIAL AND METHOD

For the phytocenological characterization of the association, the characteristic species were taken into account, species that are located only or almost only in the studied association (Borza & Boşcaiu, 1965). For the individualization and characterization of the studied association, a group of species that constantly develop in these phytocoenoses was considered.

The scientific name of the association and the name of the author were matched taking into account the International Code of Phytosociological Nomenclature, Edition 3 (Weber et al., 2000). The classification of the association into higher syntaxonomic units, suballiance, alliance, order and class was established on the basis of a group of characteristic species indicated in various specialized works, especially those developed by Oberdorfer (1977, 1978, 1983), Sanda et al., (1983), Coldea (1991, 1997), Pott (1995), Mucina (1997), Chifu (2004-2006).

The description of the plant association is based on the vegetation (floristic) relevèes that are gathered in a synthetic table. In the table, the species are presented first, those that give the name of the association, then the differential species, and in alphabetical order the characteristic species of the suballiance, alliance, order, class, and finally the accidental, random ones from various vegetation classes (Chifu et al., 2014).

The species are mentioned in the association table by their constancy (I-V), and the adopted scientific name was in accordance with the work developed by Sârbu et al., (2013). The size of the reliefs is between 400-1000 m^2 (Cristea et al., 2004).

In order to highlight the floristic similarity of the phytocoenoses corresponding to the *Symphyto cordati-Fagetum* Vida 1963 association, in the 5 studied areas the Jaccard index was used as a calculation model, determined with the help of the Past 5 statistical program.

The classification of these forest phytocoenoses into habitat type and ecosystem type was carried out according to the classification made by Doniță et al., (2005).

RESULTS AND DISCUSSIONS

Beech forests with *Symphytum cordatum* taken in the study occupy limited areas in Bihor County and were described from the Codru Moma Mountains (7 relevèes), the Plopiș Mountains (5 relevèes), the northern part of the Bihor Mountains (10 relevèes), the Pădurea Craiului Mountains (5 relevèes), the upper basin of Crișului Repede River (Iadei Valley-Drăganului Valley interfluve) (7 relevèes).

These beech forests with black burdock are widespread in Bihor County at altitudes of 460-1364 m (Table 1). The specific relief of this association is that of slopes with varied inclination (5-46°), with different exposures, plateaus and valley bottoms. The lithological substrate generally consists of basic, intermediate and rarely acid rocks. The soils on which these forests grow are of the eutricambosol, districambosol type, deep or weakly skeletal, medium-moist, with high trophicity, rich in mull-type humus.

In the tree layer, which reaches heights of 18-31 m and diameters of 20-120 cm, consistency 0.4-0.9, the dominant and edifying species is *Fagus sylvatica*. In this layer of vegetation the following species can also be sparsely found: *Acer pseudoplatanus, Abies alba, Picea abies, Ulmus glabra, Betula pendula, Acer platanoides, Fraxinus excelsior, Populus tremula, Carpinus betulus*.

The shrub layer is well represented, but has a low coverage, being made up of *Sambucus nigra, Sambucus racemosa, Corylus avellana, Euonymus latifolius, Euonymus verrucosa, Salix caprea, Rosa canina, Viburnum opulus, Staphylea pinnata*.

In the herbaceous layer, which has a general coverage of 7-100%, the high presence of black burdock is noted (Figure 1).

Figure 1 ***Symphyto cordati-Fagetum* Vida 1963, association (Dealul Ronțaru-Munții Codru Moma)**

It is an association with a rich floristic composition, totaling a number of 145 species (Table 1).

Among the species with the highest presence that subordinate the association of the *Symphyto-Fagenion* suballiance and the *Symphyto cordati-Fagion* alliance we mention: *Dentaria glandulosa, Acer pseudoplatanus, Abies alba, Festuca drymeja, Helleborus purpurascens, Aconitum vulparia* ssp. *vulparia*, *Fagetalia sylvaticae* order: *Rubus hirtus, Allium ursinum, Galium odoratum, Lamium galeobdolon,*

Mercurialis perennis, Oxalis acetosella, Athyrium filix-femina, Actaea spicata, Sanicula europaea, Asarum europaeum, *Querco-Fagetea* class: *Dentaria bulbifera, Anemone nemorosa, Dryopteris filix-mas, Hedera helix, Mycelis muralis* (Table 1).

Within this association, the species with the highest share, from the point of view of bioforms, are hemicryptophytes, followed by geophytes and phanerophytes. In the phytocoenoses of the association, the floristic elements with a large weight are Eurasian species, followed by European and Central European ones. Ecological indices highlight the dominance of mesophylous, micro-mesothermophylous, acid-neutrophylous and weakly acid-neutrophylous species, which corresponds to the distribution of these beech forests in the mountain floor on calcareous substrate (Groza, 2008; Păşcuţ 2012; Togor 2016; Pop 2024).

Table 1

***Symphyto cordati-Fagetum* Vida 1963**

Location	A	B	C	D	E
The number of relevèes carried out	7	5	10	5	7
Altitude (m)	680-900	480-740	750-1250	460-830	630-1364
Exposition	N, NE	N, NV, NE	E, V, SE, SV, NV	N, NV, S	N, NE, S, SE, E, V
Consistency of tree layer	0.8-0.9	-	0.7-0.9	0.7-0.9	0.4-0.9
Hight of the trees (m)	20-30	-	18-24	-	20-31
Trunk diametres (cm)	60-120	-	40-80	-	20-80
Herbaceous cover layer (%)	65-100	50-100	30-95	7-80	10-60
Slope (º)	5-10	5-18	2-30	15-40	8-46
Surface of relevèes (m²)	400	400	400	1000	400-800
As. *Symphytum cordatum*	V	V	V	V	V
As. *Fagus sylvatica*	V	V	V	V	V
Symphyto cordati-Fagenion, Symphyto cordati-Fagion					
Abies alba	I	I	IV	I	V
Acer pseudoplatanus	IV	II	II	·	II
Aconitum napellus ssp. *hians*	·	·	·	·	I
Aconitum variegatum ssp. *paniculatum*	·	·	I	·	I
Aconitum vulparia ssp. *vulparia*	I	I	II	·	I
Crocus vernus	·	·	·	·	II
Dentaria glandulosa	V	II	V	II	V
Euphorbia carniolica	·	I	·	·	·
Festuca drymeja	I	I	II	III	III
Helleborus purpurascens	III	III	I	II	·
Hepatica transsilvanica	·	I	·	·	·
Listera ovata	·	I	·	·	·
Moehringia muscosa	·	·	II	·	·
Pulmonaria rubra	·	·	II	·	II
Fagetalia sylvaticae					
Actaea spicata	II	II	I	I	I
Adoxa moschatellina	·	·	·	·	I
Allium ursinum	V	III	III	III	I
Anemone ranunculoides	V	III	II	II	·
Aposeris foetida	·	I	I	·	·
Arum maculatum	IV	I	I	III	·
Asarum europaeum	I	II	III	II	III
Athyrium filix-femina	III	II	III	I	IV
Atropa belladonna	I	·	I	II	·
Brachypodium sylvaticum	·	I	I	·	·
Carex sylvatica	II	I	III	·	I
Chrysosplenium alternifolium	II	·	·	·	·
Circaea lutetiana	II	II	I	·	III
Corydalis solida	III	I	·	II	·
Daphne mezereum	II	I	II	·	I
Epipactis helleborine	I	I	·	·	·
Euphorbia amygdaloides	III	II	IV	I	·
Gagea lutea	·	I	I	·	·
Galanthus nivalis	III	I	II	·	·
Galium odoratum	V	III	III	III	IV

Geranium phaeum	II	I	·	·	·
Geum urbanum	·	II	·	·	·
Impatiens noli-tangere	·	II	I	I	I
Isopyrum thalictroides	V	II	I	II	·
Lamium galeobdolon	IV	III	III	IV	IV
Lamium maculatum	II	I	·	·	II
Lathraea squamaria	·	I	·	·	II
Lathyrus vernus	I	I	II	·	·
Leucojum vernum	IV	·	I	·	III
Lilium martagon	I	·	·	·	I
Mercurialis perennis	IV	IV	III	III	I
Milium effusum	·	·	·	·	II
Myosotis sylvatica	II	I	·	·	II
Neottia nidus-avis	I	I	·	·	·
Oxalis acetosella	IV	II	IV	II	V
Paris quadrifolia	II	II	I	·	I
Polystichum aculeatum	II	·	II	I	IV
Primula elatior ssp. *leucophylla*	I	·	I	·	·
Pulmonaria officinalis	IV	IV	I	·	II
Rubus hirtus	V	IV	IV	I	V
Rubus idaeus	I	I	·	I	III
Salvia glutinosa	II	I	I	I	·
Sanicula europaea	II	II	I	I	I
Scrophularia nodosa	I	I	I	·	I
Stachys sylvatica	II	·	·	I	I
Symphytum tuberosum ssp. *nodosum*	I	II	·	·	·
Ulmus glabra	II	I	II	·	·
Querco-Fagetea					
Acer platanoides	·	I	I	I	·
Alliaria petiolata	I	I	·	·	·
Anemone nemorosa	IV	V	III	II	V
Asplenium scolopendrium	I	I	II	·	·
Betula pendula	II	I	·	·	·
Calamagrostis arundinacea	·	·	I	I	III
Carex digitata	·	I	II	·	II
Carex pilosa	I	I	II	·	·
Carex remota	·	·	·	·	I
Cardamine pratensis	·	·	·	·	I
Carpinus betulus	·	·	I	II	·
Corydalis cava	III	II	II	II	·
Cruciata glabra	·	I	·	·	·
Dentaria bulbifera	V	V	III	II	IV
Dryopteris dilatata	·	·	·	·	III
Dryopteris filix-mas	IV	III	III	IV	II
Epilobium montanum	·	·	·	·	II
Erythronium dens-canis	III	II	·	·	·
Fraxinus excelsior	·	I	II	·	·
Geranium robertianum	III	·	II	I	I
Glechoma hirsuta	III	II	I	·	I
Hedera helix	I	II	I	I	I
Hepatica nobilis	I	II	I	·	·
Lilium martagon	·	·	I	·	·
Luzula luzuloides	·	·	I	I	I
Lysimachia nummularia	·	I	·	·	·
Maianthemum bifolium	·	·	·	·	I
Moehringia trinervia	·	II	·	·	I
Mycelis muralis	I	I	I	I	III
Platanthera bifolia	I	I	I	·	I
Polygonatum odoratum	II	II	·	·	·
Populus tremula	I	I	·	·	·
Ranunculus ficaria	III	III	·	·	·
Scilla bifolia	III	II	·	I	·
Scopolia carniolica	·	I	·	·	·
Stellaria holostea	I	I	·	·	·

Stellaria nemorum	II	II	·	·	V
Viola reichenbachiana	I	II	I	·	I
Vaccinio-Piceetea					
Picea abies	·	·	IV	·	V
Luzula sylvatica	·	·	II	·	III
Homogyne alpina	·	·	I	·	I
Huperzia selago	·	·	·	·	I
Campanula abietina	·	·	·	·	I
Soldanella oreodoxa	·	·	·	·	II
Sorbus aucuparia	·	·	I	I	IV
Betulo-Adenostyletea					
Adenostyles alliariae ssp. *kerneri*	·	·	·	·	I
Doronicum austriacum	II	I	II	I	II
Gentiana asclepiadea	·	·	I	I	I
Petasites albus	·	·	·	·	III
Polygonatum verticillatum	·	·	I	·	IV
Ranunculus platanifolius	·	·	·	·	III
Ribes petraeum	·	·	I	·	·
Ribes uva-crispa	·	·	·	·	I
Veratrum album	II	·	III	·	III
Rhamno-Prunetea					
Corylus avellana	II	·	I	I	II
Euonymus latifolius	I	I	·	·	·
Euonymus verrucosa	·	I	·	·	·
Galeopsis speciosa	II	I	·	·	I
Rosa canina	I	I	·	·	·
Salix caprea	I	I	·	·	·
Sambucus racemosa	I	·	I	·	I
Sambucus nigra	IV	III	II	·	I
Staphylea pinnata	·	I	I	·	·
Viburnum opulus	·	I	·	·	·
Asplenietea trichomanis					
Cystopteris fragilis	·	·	II	·	·
Poa nemoralis	·	·	·	I	I
Polypodium vulgare	·	·	·	I	·
Saxifraga paniculata	·	·	I	·	·
Sedum maximum	·	I	·	·	·
Variae syntax					
Ajuga reptans	·	·	·	·	II
Cardamine amara	I	I	·	·	·
Cephalanthera damasonium	I	I	·	·	·
Doronicum columnae	·	I	·	·	·
Fragaria vesca	·	·	I	·	·
Lunaria rediviva	I	I	II	·	·
Senecio nemorensis	·	·	II	I	I
Solidago virgaurea	·	·	I	·	I
Spiraea chamaedryfolia	·	·	I	·	·
Telekia speciosa	·	I	·	·	·
Trollius europaeus	·	·	·	·	I
Urtica dioica	II	·	I	·	I
Veronica urticifolia	·	·	II	I	·

The place and period carrying out relevèes: A - Codru-Moma Mountains (2010-2024); B - Plopiș Mountains (1975); C - The northern side of the Bihor Mountains (2016); D - Pădurea Craiului Mountains (2008); E - The upper basin of Crișului Repede River (Valea Iadei - Valea Drăganului interfluve) (2024). K - Constance of species.

Cenotaxonomically, the *Symphyto cordati-Fagetum* Vida 1963 association, is included in the *Symphyto cordati-Fagenion* Boşcaiu et al. 1982 suballiance, the *Symphyto cordati-Fagion* Vida 1963 alliance, the *Fagetalia sylvaticae* Pawlowscki in Pwlowscki et al. 1928 order and the *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937 class.

Dendrogram of the phytocoenoses within the association (Figure 1), highlights a high similarity between all the reliefs analyzed. It is observed that the closest phytocoenoses from a floristic point of view are those of the Codru Moma Mountains (A) and the Plopiș Mountains (B), as well as those of the Bihor Mountains (C) and the upper basin of the Crișului Repede River (Iadei Valley-Drăganului Valley interfluve) (E).

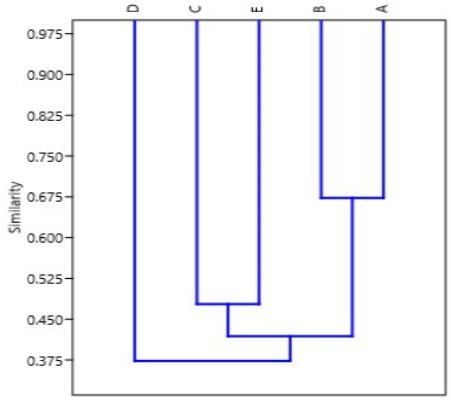

Figure 1 **Jaccard similarity index of the *Symphyto cordati-Fagetum* association, from Bihor County**

CONCLUSIONS

They are naturally rare forest ecosystems, represented by virgin and quasi-virgin secular forests, with a high conservation value, sheltering a series of rare, endangered, vulnerable, endemic, tertiary relict, monuments of nature species such as *Symphytum cordatum, Cardamine glanduligera, Crocus vernus, Pulmonaria rubra, Aconitum napellus* ssp. *hians, Aconitum variegatum* ssp. *paniculatum, Aconitum vulparia* ssp. *vulparia, Sanicula europaea, Listera ovata, Lilium martagon, Platanthera bifolia, Maianthemum bifolium, Adenostyles alliariae* ssp. *kerneri, Soldanella oreodoxa, Trollius europaeus, Neottia nidus-avis, Primula elatior* ssp. *leucophylla, Cystopteris fragilis, Saxifraga paniculata, Cephalanthera damasonium*.

The beech forests with *Symphytum cordatum* in Bihor County are important from an ecological point of view, providing basic environmental services of nature, regularization of surface runoff, erosion control, protection of hydrographic basins.

The phytocoenoses of this association are included according to the work Habitats of Romania in R4109 Southeast Carpathian beech forests (*Fagus sylvatica*) with *Symphytum cordatum*, corresponding to the Natura 2000 classification in type 91V0 Dacian beech forests (*Symphyto-Fagion*), EMERALD: !41.1 Beech forest, PAL.HAB: 41.1D211 Dacian *Dentaria glandulosa* beech forest, EUNIS: G1.6D21. Dacian *Symphytum* beech forest, with ecosystem type 3316 Beech forest with *Oxalis-Dentaria-Asperula*.

These phytocoenoses are characterized by a great floristic diversity, highlighting the group of mesophylous, microthermophylous and acid-neutrophylous species.

Regarding the floristic similarity of these forests, a stronger similarity is observed between the phytocoenoses of the Codru Moma Mountains and those of the Plopiş Mountains, as well as those of the Bihor Mountains and the upper basin of the Crişului Repede, mainly due to the geological, geomorphological and climatic factors that characterize these regions.

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