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VEGETAL ASSOCIATIONS OF THE ORDER FAGETALIA SYLVATICAE PALOWLOWSKI ET AL. 1928 IN BERZUNTI MOUNTAINS, BACĂU COUNTY

IRINA-MĂDĂLINA ARDEI*

ABSTRACT

In this paper we present two of the forest associations in Berzunţi Mountains area, which belong to the class QUERCO-FAGETEA Br.-Bl et Vlieger in Vlieger 1937. During 2008-2010 we investigated the phytocenoses of the associations : *Pulmonario rubrae-Fagetum* (Soó 1964) Taüber 1987 and *Symphyto cordati-Fagetum* Vida 1963. The description of these associations in the researched territory is accompanied ny phytocenological tables and the analysis of the bioforms and the floristic elements.

Key words: vegetal associations, forest, Berzunţi Mountains

Introduction

The Berzunţi Mountains are situated in the eastern extremity of the Eastern Carpathians, its borders are: to the North – Tarcău Mountains, to the West – Dărmăneşti Depression, to the East and to the South – Tazlău Subcarpathians.

The researched territory (the Berzunţi Mountains area) has a 140 km² surface and includes various types of mountain and hill relief, with a great diversity of the biotops. The forest area has deţine 47 % of the researched territory, this paper referring to phytocenoses of the following associations: *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 and *Symphyto cordati-Fagetum* Vida 1963.

Matherial and method

The species nomenclature complies with the books *Flora ilustrată a României – Pteridophyta et Spermatophyta* (3) cu *Flora ilustrată a plantelor vasculare din Estul României* (14) and *Flora R.P.R.-R.S.R*. (15). The determination of the bioform types and the floristic elements was made according to *Flora cormofitelor spontane şi cultivate din România* (10). The ecological indices for each analyzed species were settled according to the book *Flora şi vegetaţia Moldovei (România), vol. I.* (2)

To study the vegetation in the Berzunţi Mountains area we used the phytocenological survey method of the Zürich-Montpellier Phytocenological-floristic Central-European School. The fundamentals of this School were established by Josias Braun-Blanquet (from Zürich) and J. Pavillard (from Montpellier).

Results and discussions

Taking into consideration the book *Flora şi vegetaţia Moldovei (România),* vol. II (2) and other phytosociological papers of nomenclature and calssification (1.2,4,7-9,11-13), the associations taken into study were classified as follows:

CLASS QUERCO-FAGETEA Br.-Bl et Vlieger in Vlieger 1937
Order *FAGETALIA SYLVATICAE* Palowlowski al. 1928
Alliance *Symphyto-Fagion* Vida 1963
Suballiance *Symphyto-Fagenion* Boşcaiu et al. 1982
*Association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 (*Abieto –Fagetum* (Knapp 42) Domin 33 - MITITELU D., BARABAŞ N., 1978: Larga-Dofteana), Plaiul Stogului, Dealul Ursoaia, Dealul Măgura, Plaiul Plopatului
*Association *Symphyto cordati-Fagetum* Vida 1963 (*Fagetum carpaticum* Klika 27 Dofteana,- BARABAŞ N., 1978: Buda- Berzunţi, Berzunţi, Brăteşti- Bârsăneşti), Vârful Bulimandru, Dealul Praghilei, Dealul Drăcoaia, Dealul Osoiului

The description of the vegetal associations

1. Association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987; Syn.: Pulmonario rubrae-Abieto-Fagetum Soó 1964; Abieti-Fagetum sensu auct.; Abietum dacicum Beldie 1951
Mixed beech and fir forests

* "Ion Borcea" Natural Science Museum Complex, Aleea Parcului street, no. 9, Bacău, irinahaidau@yahoo.com

Corology and stational conditions

The association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987 with a large spreading in the Berzunţi Mountains, was previously cited in Larga-Dofteana (MITITELU D., BARABAŞ N., 1978) with the name *Abieto –Fagetum* (Knapp 42) Domin 33. During our research we identified phytocenoses of this association made by *Fagus sylvatica* and *Abies alba* at Plaiul Stogului, Dealul Ursoaia, Dealul Măgura şi Plaiul Plopatului, they are situated on large areas. The mixture of beech and fir forests can be generally found on the Western and North-Western slopes, between 600-850 m altitude, the thickness of the trees varies between 25 cm to 80-90 cm, with heights between 20-25 m and ages between 50-140 years. The forests made by *Fagus sylvatica* and *Abies alba* grow on slightly inclined terrains (15-20 degrees) or slightly abrupt (30 degrees), on soils with poor acid-neutral reaction.

Floristic composition and phytocenological structure

The floristic composition is generally rich and varied. The tree stratum of the mixed beech and fir brush, in various proportions, has a coverage between 70% and 90%. The two species *Fagus sylvatica* and *Abies alba* are, mostly, in a codominance relation, besides them are the species *Picea abies, Acer platanoides, Fraxinus excelsior* etc. The bush stratum has a less obvious coverage, generally under 2%, made by the species *Viburnum opulus, Rosa canina* etc. The regeneration stratum id formed by the juveniles of the tree species: *Fagus sylvatica*, *Abies alba* şi *Acer platanoides,* so the natural regeneration is useful in both codominant species. The herbaceous stratum varies in coverage (5-20%) but also in composition, being better developed when the opening of the canopy is larger. Regarding the phytocenological structure of the association, besides the species characteristic to the association, *Pulmonaria rubra*, we noticed as frequent the species characteristic to the sualliance *Calamagrostio- Fagenion*, alliances *Symphyto cordati- Fagion* and *Lathyro hallersteinii-Carpinion,* orders *Fagetalia sylvaticae* and *Alno-Fraxinetalia*, class *Querco-Fagetea.* Also, in the phytocenological composition appear a series of species characteristic to the following classes: *Rhamno-Prunetea*, *Epilobietea angustifolii*, *Molinio-Arrhenatheretea* (at lower altitudes) and *Vaccinio-Piceetea* (at higher altitudes) (Table 1).

Table 1-CLASS **QUERCO-FAGETEA** Br.-Bl et Vlieger in Vlieger 193
Order *FAGETALIA SYLVATICAE* Palowlowski et al. 1928
Alliance *Symphyto-Fagion* Vida 1963
Suballiance *Symphyto-Fagenion* Boşcaiu et al. 1982
1. Association ***Pulmonario rubrae-Fagetum*** (Soó 1964) Täuber 1987

Geoelem.	Biof.	Ecological indices						Number of survey	1	2	3	4
								Altitude (m)	750	800	850	600
								Exposure	N	NV	NV	V
								Inclination (º)	15	20	30	16
								Herbaceous stratum coverage (%)	90	85	80	70
		L	T	C	U	R	N	Bush and juvenile stratum coverage (%)	-	1	1	5
								Herbaceous stratum coverage (%)	5	15	20	5
								Survey area (m²)	1000	1000	1000	1000
								Number of species	10	19	20	16
								Charact. of as.				
Carp-Balc	H	4	3	4	6	5	x	*Pulmonaria rubra*	-	-	+	-
Euc	MM	3	5	4	x	x	x	*Abies alba*	1	1	1	1
								Abies alba (juv.)	-	-	-	+
Eur	MM(M)	3	5	2	5	x	x	*Fagus sylvatica*	4	5	5	3
								Fagus sylvatica (juv)	-	+	-	-
								Symphyto cordati-Fagion et Symphyto-Fagenion				
Carp (End)	G	4	4	4	7	7	7	*Dentaria glandulosa*	-	-	+	-
Euc (Mont)	H	3	4	4	5	7	x	*Veronica urticifolia*	-	-	+	-
								Calamagrostio-Fagenion				

Eua (Cont)	H	6	5	4	5	5	5	*Calamagrostis arundinacea*	-	-	-	+
Eur	H	4	x	4	5	3	4	*Luzula luzuloides ssp. luzuloides*	+	-	+	1
								Lathyro hallersteinii-Carpinion				
Euc	G	5	5	5	4	7	4	*Galium schultesii*	-	-	+	-
Pont-Med	H-Ch	6	5	4	4	5	3	*Glechoma hirsuta*	-	+	-	-
Eua	H	5	6	3	5	6	5	*Stellaria holostea*	-	+	-	+
								Fagetalia sylvaticae				
Eur	G	3	6	4	6	8	8	*Anemone ranunculoides*	-	+	-	+
Eua	H	6	6	4	4	8	4	*Campanula rapunculoides*	-	-	-	+
Circ	H (HH)	2	5	3	5	7	5	*Carex sylvatica*	-	+	-	-
Eua	G	2	5	2	5	x	5	*Galium odoratum*	-	1	-	-
Euc	H-Ch	3	5	2	5	7	5	*Lamium galeobdolon*	-	+	-	-
Eur	H	5	x	3	6	x	7	*Myosotis sylvatica*	+	-	+	-
Circ	H-G	1	x	3	6	x	7	*Oxalis acetosella*	-	-	+	1
Eua (Mont)	H	4	5	4	6	7	7	*Salvia glutinosa*	-	-	1	-
Eur	H	4	5	3	6	6	7	*Scrophularia nodosa*	-	-	-	+
								Alnion incanae et Alno-Fraxinetalia				
Eua (Med)	G	4	5	3	6	7	7	*Circaea lutetiana*	-	-	-	+
Eur	MM	4	5	3	x	7	7	*Fraxinus excelsior*	-	-	-	+
Eua	Th	4	5	5	7	7	6	*Impatiens noli-tangere*	-	-	1	-
Eua	H	4	x	3	7	7	7	*Stachys sylvatica*	-	-	+	-
Circ	M	6	5	3	7	7	6	*Viburnum opulus*	-	-		+
								Querco-Fagetea				
Eur	MM	4	7	8	4	7	x	*Acer platanoides*	-	-	-	+
								Acer platanoides (juv.)	-	-	-	+
Circ	G	x	x	3	x	5	x	*Anemone nemorosa ssp. nemorosa*	-	+	-	-
Cosm	H	4	x	3	7	x	6	*Athyrium filix-femina*	-	+	-	-
Eua (Med)	H	4	5	3	5	6	6	*Brachypodium sylvaticum*	+	-	-	-
Eua	H	7	6	4	5	6	6	*Cruciata glabra*	-	+	-	-
Cosm	H	3	x	3	5	5	6	*Dryopteris filix-mas*	+	+	+	-
Eua	H	4	x	3	5	6	6	*Epilobium montanum*	-	-	+	-
Alt-Med	N-E	4	5	2	5	x	x	*Hedera helix*	-	-	+	-
Eua (Med)	Th (TH)	4	5	3	5	6	7	*Moehringia trinervia*	-	+	-	-
Eua	H	4	5	4	5	7	6	*Viola reichenbachiana*	-	1	-	+
								Rhamno-Prunetea				
Euc (Med)	N-E	7	7	3	5	7	7	*Clematis vitalba*	-	-	+	-
Eur	N	8	6	2	3	8	3	*Rosa canina*	-	-	+	-
								Vaccinio-Piceetea				
Eur	MM	5	3	6	x	x	x	*Picea abies*	-	+	-	-
Eur	MM-M	6	x	x	x	x	x	*Sorbus aucuparia*	-	-	+	-
								Epilobietea angustifolii				
Alt-Med-Euc	H	6	6	2	5	8	8	*Atropa belladona*	+	-	-	-
Eua	Th	7	x	6	5	x	8	*Galeopsis speciosa*	+	-	-	-
Circ	H	5	x	x	5	x	5	*Solidago virgaurea ssp. virgaurea*	+	-	-	-
								Molinio-Arrhenatheretea				
Circ	G	5	7	2	8	8	5	*Equisetum telmateia*	-	+	-	-
Cosm	H	7	x	3	x	x	x	*Prunella vulgaris*	-	-	-	+
Eur	Ch	4	6	4	6	x	1	*Lysimachia nummularia*	-	-	+	-
Eua (Med)	H	7	x	5	8	7	5	*Valeriana officinalis*	-	-	+	-
								Variae syntaxa				
Eua	H	8	x	x	5	x	x	*Plantago major ssp. major*	-	+	-	+
Eur	H	4	5	2	8	7	7	*Rumex sanguineus*	+	-	-	-

Eua (Med)	Ch-N	7	5	x	8	x	8	*Solanum dulcamara*	-	+	-	-
Cosm	H	x	x	x	6	x	8	*Urtica dioica*	-	+	-	+

Place and time of surveys: 1. Plaiul Stogului (01.09.2008), 2. Dealul Ursoaia (30.06.2009), 3. Dealul Măgura (10.07.2010), 4. Plaiul Plopatului (10.07.2010)

Bioform spectrum: From the analysis of the bioform spectrum, we can state the numerical dominance of hemicryptophytes (H) with 55,09%, followed by phanerophytes (Ph) with 20,04%, geophytes (G) with 14,28%, annual terophytes (Th) with 6,12% and then camephytes (Ch) with 4,08% of the total number of identified species (Fig. 1).

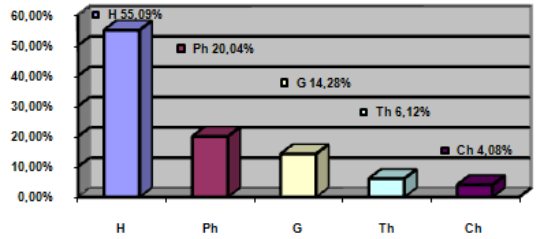

Fig. 1 - Bioform spectrum of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987

Floristic element spectrum: From the analysis of the floristic elements, we can say that the Eurasian element (Eua) is dominant with 34,68%, followed by the European one (Eur) with 24,48%. The Central European element (Euc) has 10,02%. Other elements have important proportions: circumpolar (Circ) with 12,24 % and cosmopolitan (Cosm) with 8,16%. The carpathian elements (balkanic-carpathian and endemic-carpahian) have 4,08% - their presence showing the conservative value of these forests. The other elements have each 2,04% (Fig. 2).

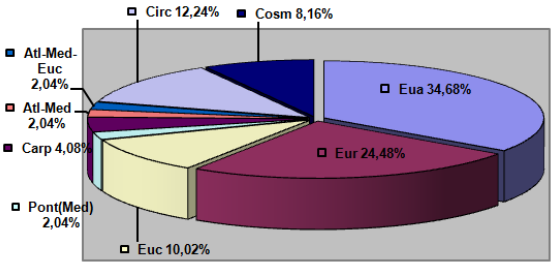

Fig. 2 – Floristic element bioform spectrum of the association *Pulmonario rubrae-Fagetum* (Soó 1964) Täuber 1987

2. Association *Symphyto cordati - Fagetum* Vida 1963

Syn.: Symphyto cordati-Fagetum Vida 1959, Fagetum carpaticum sensu auct., Fagetum dacicum nemorale Beldie 1951
Beech forests

Corology and stational conditions

The association *Symphyto cordati-Fagetum* Vida has been previously mentioned in Berzunţi Mountains in the villages: Dofteana, Buda - Berzunţi, Berzunţi, Brăteşti- Bârsăneşti (BARABAŞ N., 1974 şi 1978, MITITELU D., BARABAŞ N., 1978) under the name *Fagetum carpaticum* Klika 27, but also in the area of Sfântul Sava Monastery (PAPP, C., BÂRCĂ, C., 1960). In this association we included the pure beech forests situated at altitudes between 500 and 800 m on Vârful Bulimandru, Dealul Drăcoaia, Dealul Praghilei şi Dealul Osoiului, having a large spreading, but still smaller than the association *Pulmonario rubrae-Fagetum*. The phytocenoses of this association occupy slightly inclined terrains (15-35 degrees), preferring especially western slopes, and less the eastern and north-western ones. The beech forests in these areas are 100-130 years old, with a thickness up to 90 cm and heights of 20-25 m.

Floristic composition and phytocenotic structure

In the tree stratum, besides the edificating dominant species, *Fagus sylvatica,* also appear sporadic specimens of *Abies alba, Tilia cordata, Betula pendula, Picea abies* etc. The coverage of the tree stratum varies between 70% and 85%. The shrub stratum may not be present or it has a poor coverage, with an average under 3% in which sporadically develop: *Corylus avellana, Cornus sanguinea, Crataegus monogyna* etc. The regeneration stratum is poorly developed, the regeneration happens hardly because of the thick litter (7-15 cm). The herbaceous stratum has a poor coverage, 20% at best, being better developed in the spring and in summer beginning when the herbaceous stratum coverage is better.

Regarding the phytocenotic structure of the association, we identified species characteristic to the alliance *Symphyto cordati-Fagion* (*Abies alba, Neottia nidus-avis* etc.), order *Fagetalia sylvaticae (Actaea spicata, Isopyrum thalictroides, Salvia glutinosa* etc.) and class *Querco-Fagetea (Hedera helix, Dryopteris filix-mas, Brachypodium sylvaticum* etc.). Also, we can notice a series of

species characteristic to the classes: *Galio-Urticetea, Rhamno-Prunetea* (Table 2). *Vaccinio-Piceetea, Epilobietea angustifolii,*

Table 2-CLASS **QUERCO-FAGETEA** Br.-Bl et Vlieger in Vlieger 1937
Order *FAGETALIA SYLVATICAE* Palowlowski et al. 1928
Alliance *Symphyto-Fagion* Vida 1963
Suballiance *Symphyto-Fagenion* Boşcaiu et al. 1982
2. Association ***Symphyto cordati-Fagetum*** Vida 1963

Geoelem.	Biof.	Ecological indices										
								Number of survey	1	2	3	4
								Altitude (m)	600	800	500	550
								Exposure	E	V	NV	V
								Inclination (º)	15	35	30	15
								Tree stratum coverage (%)	70	70	85	70
		L	T	C	U	R	N	Bush and juvenile stratum coverage (%)	5	-	-	5
								Herbaceous stratum coverage (%)	10	20	10	15
								Survey area (m²)	1000	1000	1000	1000
								Number of species	15	18	14	10
								Charact. of as.				
Eur	MM (M)	3	5	2	5	x	x	*Fagus sylvatica*	4	4	5	4
								Symphyto cordati-Fagion et Symphyto-Fagenion				
Euc	MM	3	5	4	x	x	x	*Abies alba*	+	-	-	-
Carp(End)	G	4	4	4	7	7	7	*Dentaria glandulosa*	-	-	-	+
Eua	G	2	5	3	5	7	5	*Neottia nidus-avis*	-	+	-	-
								Lathyro hallersteinii-Carpinion				
Eur	MM	4	5	4	x	x	5	*Tilia cordata*	-	-	-	+
Pont-Med	H-Ch	6	5	4	4	5	3	*Glechoma hirsuta*	+	-	-	-
								Fagetalia sylvaticae				
Eua	H	x	3	x	3	3	x	*Actaea spicata*	-	+	-	-
Eua	H	6	6	4	4	8	4	*Campanula rapunculoides*	-	+	+	-
Circ	H (HH)	2	5	3	5	7	5	*Carex sylvatica*	-	-	-	+
Eur (Med)	Ch	4	5	2	5	7	6	*Euphorbia amygdaloides*	+	+	-	-
Eua	G	2	5	2	5	x	5	*Galium odoratum*	-	+	-	-
Eur	G	4	6	5	5	5	4	*Isopyrum thalictroides*	-	+	-	-
Euc	H-Ch	3	5	2	5	7	5	*Lamium galeobdolon*	-	-	-	+
Circ	H-G	1	x	3	6	x	7	*Oxalis acetosella*	+	+	-	+
Eur	H	5	6	5	5	8	6	*Pulmonaria officinalis*	-	+	-	-
Eua (Mont)	H	4	5	4	6	7	7	*Salvia glutinosa*	+	-	+	-
Eua	H	4	5	3	5	8	6	*Sanicula europaea*	-	-	+	-
								Alnion incanae et Alno-Fraxinetalia				
Atl-Med	H	5	5	2	8	6	5	*Carex pendula*	-	-	+	-
Eua (Med)	G	4	5	3	6	7	7	*Circaea lutetiana*	+	+	+	-
Eua	H-Ch	6	5	3	6	x	7	*Glechoma hederacea*	-	+	-	-
Eua	Th	4	5	5	7	7	6	*Impatiens noli-tangere*	+	-	+	-
								Querco-Fagetea				
Cosm	H	4	x	3	7	x	6	*Athyrium filix-femina*	-	1	-	-
Eua (Med)	H	4	5	3	5	6	6	*Brachypodium sylvaticum*	-	+	-	-
Euc	G	3	5	4	5	7	6	*Dentaria bulbifera*	-	-	+	-
Cosm	H	3	x	3	5	5	6	*Dryopteris filix-mas*	+		+	+
Med (Circ)	H	4	5	5	5	x	7	*Geum urbanum*	-	-	-	-

Atl-Med	N-E	4	5	2	5	x	x	*Hedera helix*	-	-	+	-
Eur	H	4	5	2	5	x	6	*Mycelis muralis*	+	-	-	-
								Rhamno-Prunetea				
Eua	MM (M)	7	x	x	x	x	x	*Betula pendula*	-	-	+	-
Balc	M	6	5	3	x	x	x	*Corylus avellana*	+	-	-	-
Euc	M	7	5	4	x	8	x	*Cornus sanguinea*	-	-	-	+
								Vaccinio-Piceetea				
Euc	H	4	4	2	6	2	5	*Luzula sylvatica*	-	+	-	-
Eur	MM	5	3	6	x	x	x	*Picea abies*	+	-	-	-
								Epilobietea angustifolii				
Eua	H	5	x	5	5	x	6	*Fragaria vesca*	+	-	-	+
Circ	H	5	x	x	5	x	5	*Solidago virgaurea ssp. virgaurea*	+	-	-	-
								Galio- Urticetea				
Eua	H	5	x	3	6	7	8	*Aegopodium podagraria*	-	-	-	+
								Variae syntaxa				
Eua	M	7	5	3	4	8	3	*Crataegus monogyna*	-	-	+	-
Euc (Mont)	H	7	x	4	6	7	x	*Gentiana asclepiadea*	-	-	+	-
Eua	H	4	5	3	7	6	6	*Festuca gigantea*	-	+	-	-
Eua (Cont)	H-Ch	8	7	5	4	7	7	*Nepeta nuda*	-	+	-	-
Eua	H	3	x	x	6	7	6	*Paris quadrifolia*	-	+	-	-
Circ	H	5	x	5	5	5	5	*Poa nemoralis*	-	-	+	-
Circ	N	7	x	x	5	x	8	*Rubus idaeus*	-	+	-	-

Place and time of survey: 1. Dealul Praghilei (24.07.2008); 2. Vârful Bulimandru (27.07.2009); 3. Dealul Drăcoaia (01.08.2010); 4. Dealul Osoiului (28.08.2010)

The bioform spectrum shows the numerical dominance of hemicryptophytes (H) with 58,12%, followed by phanerophytes (Ph) with 18,58%. The geophytes (G) have 13,95%, the camephyytes (Ch) and the terophytes (Th) being equally represented with 2,32% each (Fig. 3).

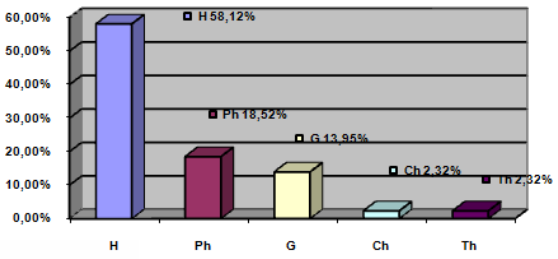

Fig. 3 – The bioform spectrum of the association *Symphyto cordati-Fagetum* Vida 1963

The floristic element spectrum shows the dominance of the Eurasian element (Eua) with 39,52% of the total number of identified species. It is followed by the European species (Eur) with 16,27%, the Central-European (Euc) with 13,94%, the circumpolar (Circ) with 11,62%, the cosmopolitan (Cosm) and the Atlantic-Mediterranean (Atl-Med) with 4,65% each. The endemic-carpathian – Carp (End), the balkanic (Balc), the Pontic-Mediterranean (Pont-Med) have 2,32% each (Fig. 4).

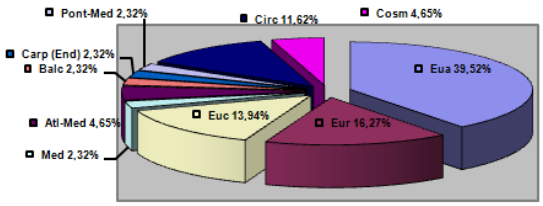

Fig. 4 – The floristic element spectrum of the association *Symphyto cordati-Fagetum* Vida 1963

Conclusions

1. The forest vegetation (class *QUERCO-FAGETEA*) can be included in the nemoral stratum (deciduous forests), i.e. in the substratum of the beech and mixed forests. The main forest group in the mentioned substratum is the fir-beech group (*Pulmonario rubrae-Fagetum*), also sporadically appear pure beech forests (*Symphyto cordati-Fagetum*), spruce-beech forests (*Leucanthemo waldsteinii-Fagetum*) and hornbeam-beech forests (*Galio schultesii-Fagetum*);

2. The floristic composition of the phytocenoses of the two researched associations is diverse.
3. The bioform spectrum and the geoelement spectrum of the two researched associations confirms the data in the specialty literature.

Rezumat

În această lucrare sunt prezentate două dintre asociaţiile de pădure din zona Munţiilor Berzunţi, care aparţin clasei QUERCO-FAGETEA Br.-Bl et Vlieger in Vlieger 1937. În perioada anilor 2008-2010 au fost investigate fitocenozele asociaţiilor: *Pulmonario rubrae-Fagetum* (Soó 1964) Taüber 1987 şi *Symphyto cordati-Fagetum* Vida 1963. Descrierea acestor asociaţii din teritoriul investigat este însoţită de tabele fitocenologice precum şi de analiza bioformelor şi a elementelor floristice.

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