CONTRIBUTIONS TO THE KNOWLEDGE OF ROMANIAN YEW-BEECH FORESTS

Togor George Claudiu *, Burescu Petru **

* University of Oradea, Faculty of Sciences, Biology Department, PhD Student, 1 University St., Oradea, Romania, e-mail: togorg@gmail.com
** University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: pburescu@gmail.com

Abstract

This paper presents phytocoenologic, ecological and eco-protective research done in the northern part of Bihor Mountains, the yew-beech forests developed on calcareous rocks. The phytocoenoses of the association Taxo – Fagetum Etter 1947*, less widespread in Romania, have been identified in the northern part of Bihor Mountains in several places with small areas, at Pietrele Galbenei rocks, Pietrele Negre rocks, the Galbena Gorges. The association is distinguished by the presence of some protected species, including the Carpathian endemism Primula elatior ssp. leucophylla, the vulnerable species Taxus baccata, Sempervivum marmoreum, Dianthus ssp. kitaibelii spiculifolius, Gentiana clusii, the rare species Teucrium montanum.*

Key words: *Taxo-Fagetum*, life forms, floristic elements, ecological factors, protected species.

INTRODUCTION

The Yew (Taxus baccata L.), tertiary relict shrub species, is protected in Romania as a natural monument, with a sporadic distribution in beech-fir forests, often on the rocky, mountain floor. It is a vulnerable species, registered on the Red List (Boşcaiu et al., 1994, Dihoru et Negrean, 2009).

The phytocoenoses edified by *Taxus baccata*, *Fagus sylvatica* and *Abies alba* belong the association *Taxo – Fagetum* Etter 1947, are widespread in Europe from the Jura Mountains and the Swiss Alps (Hartmann et Jahn, 1967) to the land of Lake Bodensee in Germany (Oberdorfer, 1957). In Romania, these phytocoenoses presents as a specific a lower co-dominant character of the yew, edifying species together with beech (Cristian-Comes et Täuber, 1977).

The association *Taxo – Fagetum* Etter 1947 (Syn.: *Pulmonario rubrae – Abieti – Fagetum taxetosum baccatae* Comes et Täuber 1977) have been described in the Piatra Craiului Massif (Cristian-Comes et Täuber, 1977) and the Curvature Sub-Carpathians (Chifu et al., 2006). In the analyzed area by us, the northern part of Bihor Mountains, the association was identified at Pietrele Galbenei rocks, Pietrele Negre rocks and the Galbena Gorges on relatively small areas, up to 1000 sqm. The localities where vegetate these phytocoenoses are characterized by superficial rendzinic soils, brown or brown eumesobasic soils, poor in humus, with blocks of limestone to the

surface, the exhibition generally southern, slope with high inclination (45-70°).

MATERIAL AND METHODS

The association *Taxo – Fagetum* Etter 1947 (Syn.: *Pulmonario rubrae – Abieti – Fagetum taxetosum baccatae* Comes et Täuber 1977) was framed (Boşcaiu et al., 1982, Sanda et al., 2008) in the following coeno-system at the sub-alliance of Carpathian pure beech forests or mixed with fir and spruce, in the climax stage or different stages of sub-climax:
QUERCO – FAGETEA Br.-Bl. et Vlieger in Vlieger em. Borhidi 1996
Fagetalia sylvaticae Pawłowski in Pawłowski et al. 1928
Symphyto cordati – Fagion Vida 1959
Symphyto – Fagenion Boşcaiu et al.1982

During the field observations and research, we have used methods of phytosociological research of the Central-European School, based on the principles and methodologies developed by Braun-Blanquet (1928) and adapted by Borza (1934), Borza et Boşcaiu (1965) to the particularities of the vegetation layer in our country. The phytocoenological surveys done during the field trips organized between May 2010 – August 2011 comprised sample surfaces that were homogenous from a floristic and physiognomic point of view, which were chosen in the fragments characteristic to the researched phytocoenoses, from 400 to 800 sqm.

The quantitative appreciation of each species' participation in the description of the associations has been done by means of the abundance-dominance index (AD), by the Braun-Blanquet et Pavillard (1928) evaluation system, completed by Tüxen et Ellenberg (1937). The association table elaborated contains information regarding the species that make the floristic composition of the association, the life forms, the floristic elements, ecological indexes (humidity, temperature, the chemical soil reaction), the karyologic index, the recorded number of the survey, the altitude (m.s.m.), the exposure, inclination (degrees), the trees' consistency (%), the grassy layer (%), the moss layer (%), the surface (sqm), the place and date of the surveying. The constancy (K) and the average abundance-dominance (ADm) were calculated and introduced at the end of the table. In order to bring the ecological study of the association to a whole, we have represented graphically the distribution of biological forms, of floristic elements, of ecologic factors and karyologic indexes.

RESULTS AND DISCUSSION

The characteristic species for the association are: *Fagus sylvatica* and *Taxus baccata*. The number of common yew, which appear insular in these phytocoenoses, are highly branched shrubs at the base, tapered, with heights of 1.5-2.5 m and diameters of 10-20 cm; were older than 150 years, are accompanied by the seedlings. Most of them grow under the shelter of rocky slopes, limestone, or in the proximity of fir, which provide a moderate temperature (6-10°C), compared to average temperature (0-6°C) characteristic of this area, and maintenance regime for the atmospheric moisture.

In terms of floristic composition, the association *Taxo - Fagetum* Etter 1947 from the northern part of Bihor Mountains include 69 taxa (Table 1). Tree layer, with over 100 years old, has a consistency between 0.2-0.7 is dominated by *Fagus sylvatica*, alongside are also found the deciduous *Acer pseudoplatanus, Betula pendula, Sorbus aucuparia, Sorbus graeca, Salix capraea* and conifers (*Taxus baccata, Picea abies* and *Abies alba*).

The relevées carried out highlight the weak presence of youth and seedling in the phytocoenoses, consisting of species: *Salix capraea, Sorbus aucuparia, Picea abies,Taxus baccata* rare. The herbaceous layer, with a coverage between 35-40%, is composed of subordinate species the alliance *Symphyto cordati – Fagion* (*Aconitum moldavicum, Primula elatior* ssp. *leucophylla*), suballiance *Moehringio muscosae – Acerenion* (*Asplenium scolopendrium, Geranium robertianum, Moehringia muscosa, Veronica urticifolia*), order **Fagetalia sylvaticae** (*Asarum europaum, Campanula rapunculoides, Euphorbia amygdaloides, Gymnocarpium dryopteris, Lamium galeobdolon, Lathyrus vernus, Mercurialis perennis, Sanicula europaea*), class **Querco – Fagetea** (*Poa nemoralis, Carex digitata, Galium schultezii, Hepatica nobilis, Mycelis muralis*). Besides these, in the association phytocoenoses have entered transgressive species from classes **Asplenietea trichomanis** (*Asplenium ruta-muraria, Asplenium trichomanes* ssp. *quadrivalens, Kernera saxatilis*), **Seslerietea albicantis** (*Sesleria rigida, Trisetum alpestre, Doronicum columnae, Phyteuma orbiculare, Seseli libanotis*), **Festuco – Brometea** (*Sempervivum marmoreum, Brachypodium pinnatum, Dianthus spiculifolius, Scabiosa ochroleuca, Teucrium montanum, Vincetoxicum hirundinaria*), **Trifolio – Geranietea sanguinei** (*Campanula persicifolia, Galium album*), **Rhamno – Prunetea** (*Rubus idaeus, Calamagrostis arundinacea, Polystichum lonchitis, Vaccinium myrtillus, Valeriana tripteris*). A total of 21 accidental or incidental species were identified in the relevées carried out, occurring in neighboring coenotic groups, were brought by wind or animals or representing remnants of the evolution stages of phytocoenoses.

The phytocoenoses of the association accommodating a number of protected species, including: Carpathian endemic *Primula elatior* ssp. *leucophylla*, vulnerable species *Taxus baccata, Sempervivum marmoreum, Dianthus kitaibelii* ssp. *spiculifolius*, *Gentiana clusii*, rare species *Teucrium montanum*.

Table 1

The association *Taxo – Fagetum* Etter 1947

Life - form	Floristic elem.	U	T	R	G	Relevées Number	1	2	3
						Altitude (m)	1230	1240	860
						Exposition	S	SE	SV
						Slope (º)	70	45	60
						Consistency of tree layer	0.4	0.2	0.7
						Hight of the trees (m)	10	8	18
						Diameter of trees (cm)	36-40	28-30	34-38
						Cover of herbaceous layer (%)	40	40	35
						Surface (sqm)	400	400	400
MPh	E	3	3	0	D	*Fagus sylvatica*	+	2	4
mPh	E(mont)	3	3.5	4	D	*Taxus baccata*	+	+	+
						Moehringio muscosae - Acerenion			
MPh	Ec	3.5	3	3	P	*Acer pseudoplatanus*	+	+	+
G	Cp(bor)	3.5	3	5	D	*Asplenium scolopendrium*	.	.	+
Th	Cosm	3.5	3	3	P	*Geranium robertianum*	.	+	+
H	Ec(mont)	4	2	4	D	*Moehringia muscosa*	+	.	+
H	Ec(mont)	3	2.5	4	DP	*Veronica urticifolia*	.	+	+
						Symphyto cordati - Fagion			
MPh	Ec	4	3	0	D	*Abies alba*	3	+	.
H	Ec	4	2.5	4	D	*Aconitum moldavicum*	.	.	+
H	Eua	3	3	4	D	*Primula elatior* ssp. *leucophylla*	.	.	+
						Fagetalia sylvaticae			
H-G	Eua	3.5	3	4	DP	*Asarum europaeum*	.	.	+
H	Eua(M)	3	2	0	DP	*Campanula rapunculoides*	.	.	+
Ch	E(M)	3	3.5	4	DP	*Euphorbia amygdaloides*	.	+	+
G	Cp(bor)	3	2.5	2	P	*Gymnocarpium dryopteris*	.	.	+
H(Ch)	Ec	3	0	4	D	*Lamium galeobdolon*	.	.	+
H	Eua	3	3	3	D	*Lathyrus vernus*	+	+	+
H-G	E	3.5	3	4	P	*Mercurialis perennis*	+	+	.
H	Atl-M	3.5	3	4	D	*Sanicula europaea*	.	+	
						Querco - Fagetea			
H	E	3	3	3	P	*Carex digitata*	.	.	+
G	Ec	2.5	3	3	P	*Galium schultesii*	.	.	+
G	E	3	3	4	D	*Hepatica nobilis*	.	+	+
H	E	3	3	0	D	*Mycelis muralis*	.	.	+
H	Eua	3	3	0	DP	*Poa nemoralis*	.	.	1
						Asplenietea trichomanis			
H	Cp(bor)	1.5	3	5	P	*Asplenium ruta-muraria*	+	.	+
H	Cosm	3	0	4	P	*Asplenium trichomanes* ssp. *quadrivalens*	.	.	+
H	E(alp)	2	1.5	0	DP	*Kernera saxatilis*	+	.	.
						Seslerietea albicantis			
H	Alp-Carp-B	3.5	2	3.5	P	*Doronicum columnae*	.	+	+
H	Ec(mont)	0	2	4.5	D	*Phyteuma orbiculare*	.	+	.
H	Eua(cont)	3	0	4	DP	*Seseli libanotis*	.	.	+
H	Carp-B	2.5	2	4.5	P	*Sesleria rigida*	3	2	2
H	Alp-Carp-B	2.5	2	0	D	*Trisetum alpestre*	.	1	.
						Festuco - Brometea			
H	Eua(M)	2.5	4	4	DP	*Brachypodium pinnatum*	+	.	.
H	Carp(end)	2	3.5	4	N	*Dianthus kitaibelii ssp.spiculifolius*	.	+	.
H	Eua(cont)	2	4	4	D	*Scabiosa ochroleuca*	.	+	.
Ch	Carp-B	1.5	2.5	2.5	DP	*Sempervivum marmoreum*	+	+	.
Ch	M-Ec	1	4	5	P	*Teucrium montanum*	.	+	.
H	E(M)	2	4	4	D	*Vincetoxicum hirundinaria*	.	+	.

Table 1(Continued)

Life - form	Floristic elem.	U	T	R	G	Relevées Number	1	2	3
						Trifolio - Geranietea sanguinei			
H	Eua(M)	3	3	0	D	*Campanula persicifolia*	.	+	+
H	Eua	2.5	2.5	3	P	*Galium album*	+	+	.
						Rhamno - Prunetea			
mPh	Eua	3	3	3	DP	*Salix caprea*	+	.	.
MPh-mPh	Eua	3	2	2	P	*Betula pendula*	+	.	.
nPh	Cp(bor)	3	3	3	DP	*Rubus idaeus*	+	.	.
						Vaccinio - Piceetea			
H(G)	Eua	2.5	3	2	P	*Calamagrostis arundinacea*	1	+	.
MPh	E	0	0	0	D	*Picea abies*	.	+	1
H	Cp(bor)	3	1.5	4.5	D	*Polystichum lonchitis*	.	.	+
MPh-mPh	E	3	2.5	2	D	*Sorbus aucuparia*	+	.	.
nPh (Ch)	Cp(bor)	0	2	1	D	*Vaccinium myrtillus*	+	.	.
H	Ec(mont)	3	0	4.5	D	*Valeriana tripteris*	.	+	.
						Variae syntaxa			
TH-H	M	2	4	4	DP	*Arabis turrita*	+	.	+
H	Cp(bor)	4	2	4	D	*Asplenium viride*	+	.	.
H	Cp(bor)	2	0	3	DP	*Campanula rotundifolia* ssp. *rotundifolia*	+	+	+
TH-H	Ec	2.5	3	4	P	*Cardaminopsis arenosa*	+	.	.
H	Alp-Carp	2	0	5	P	*Carex ornithopoda*	.	+	.
G	E	2	3	5	P	*Cephalanthera rubra*	.	+	.
H	Ec(mont)	3	3	4.5	D	*Cirsium erisithales*	.	+	+
H	Carp-B-Apen	2	3.5	3.5	N	*Edraianthus graminifolius*	.	+	.
H	Eua(M)	4	3	0	D	*Eupatorium cannabinum*	.	.	+
H	Alp-Carp	3	2	5	P	*Gentiana clusii*	.	+	.
H	Ec	2.5	2	4.5	P	*Hieracium bifidum*	.	+	.
H	Ec	2.5	3	4	N	*Peucedanum austriacum*	.	+	.
H	Eua(bor)	3	3	0	P	*Sanguisorba officinalis*	.	+	.
Ch	Carp-B	2	2.5	4.5	N	*Saxifraga marginata*	+	.	.
Ch	Carp-B	1.5	2	0	D	*Sempervivum heuffelii*	+	+	.
H	Eua	3.5	3	3	P	*Senecio germanicus*	.	.	+
H	Carp-B	3	2	2.5	P	*Senecio papposus*	.	+	.
mPh	M-Ec	2.5	3	4	D	*Sorbus graeca*	.	+	.
Ch	Pont-Pan	2	4	0	P	*Thymus glabrescens*	.	+	.
Ch	Eua(cont)	1.5	3.5	4	D	*Thymus pannonicus*	+	.	.
H	Eua(M)	4	3	4	D	*Valeriana officinalis*	+	.	.
TH-H	Dac-B	3	2	3	N	*Verbascum lanatum* var. *hinkei*	+	.	.

Place and date when the surveys: 1. Piatra Galbenei, 25.05.2010; 2. Pietrele Negre, 09.07.2010; 3. Cheile Galbenei, 10.08.2011.

Analyzing the behavior of phytocoenoses species to the three environmental factors (humidity, temperature, chemical reaction of the soil - Fig.1), we observe the predominance of mesophylous species ($U_{3\text{-}3,5}$ = 50%) and xero-mesophylous species ($U_{2\text{-}2,5}$ = 30%) , according with dry-moist soil to moist soil, wet enough, of the localities where are stationed the phytocoenoses of the association. The micro-mesothermophylous species ($T_{3\text{-}3,5}$ = 48.5%) are predominant, followed by the microthermophylous species ($T_{2\text{-}2,5}$ = 30%), showing average annual temperature specific the mountain stage, with beech and conifers stationed on rocks. Response to

chemical soil reaction, weak acid-neutrophylous species predominates ($R_{4-4,5}$ = 44.3%).

Fig. 1 The diagram of ecological indices for the association *Taxo – Fagetum* Etter 1947, where: U - humidity, T - temperature, R - the chemical reaction of the soil.

In the life forms spectrum (Fig. 2) predominates the hemicryptophytes (H = 61.4%), followed by phanerophytes (pH = 15.8%), basic constituents of the forests, chamaephytes (Ch = 10%) and geophytes (G = 7.1%), both types proving the difficult climate conditions on the southern exhibition rocks, and finaly, terophytes (Th-TH = 5.7%) with a poor percentage, illustrate a low anthropic impact on flora and vegetation. The abundance of hemicryptophytes are largely influenced by the mild temperate climates and the natural hazards (trees felled by wind and snow).

Fig. 2 The life forms spectrum of ass. *Taxo – Fagetum* Etter 1947, where: H – hemicryptophytes, Ph - phanerophytes, Ch – chamaephytes, G – geophytes, Th-TH – terophytes.

The participation of floristic elements in the composition of the floristic elements spectrum (Fig.3) we notice a high diversity of origin of the

phytocoenoses species, predominantly Eurasian species (Eua = 25.7%), followed by Central European species (Ec = 18.6%) and European ones (E = 17.1%), the Carpathian species (Carp) totaling 10%.

Fig. 3 The spectrum of floristic elements of the ass. *Taxo – Fagetum* Etter 1947, where: Eua – Eurasian; Ec – Central European; E – European; Cp – Circumpolar; Carp – Carpathian; Alp-Carp – Alpo-Carpathian; M – Mediterranean; Cosm – Cosmopolitan; Atl-M – Atlantic-Mediterranean; DB – Dacian-Balkan; Pont-Pan – Ponto-Pannonian.

In terms of karyology, it is observed (Fig. 4) the predominance of diploid species (D = 41.4%) than polyploid species (P = 32.9%), for a total of 5 taxa not being able to determine the karyotype (N = 7.1%). The diploids index is I = 1.26.

Fig. 4 Karyologic spectrum of ass. *Taxo – Fagetum* Etter 1947, where: D – Diploid, P – polyploid, DP – diplo-polyploid, N – unknown karyotype.

CONCLUSION

The phytocoenoses of the association *Taxo – Fagetum* Etter 1947, less widespread in Romania, developed in the northern part of Bihor Mountains, the small areas located at altitudes between 860-1240 m, mainly

southern exhibitions. Have in the floristic composition, accounting for 69 taxa, a total of 6 species (8.7%) are protected, rare, vulnerable or endemic. In places described yew grows spontaneously, with an optimum development sheltered by limestone walls. The territories we studied included in the Apuseni Natural Park, but the regime of protection should be directed towards the effective protection of their natural habitats.

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