RESEARCH OF ECOLOGICAL GENETICS ON EUROPEAN BEECH-SILVER FIR STAND AND NORWAY SPRUCE-EUROPEAN BEECH-SILVER FIR STAND WITH HUNGARIAN LILAC (*SYRINGA JOSIKAEA*) IN THE APUSENI MOUNTAINS, VALEA IADULUI VALLEY BASIN. ASSOCIATION *PULMONARIO RUBRAE - FAGETUM*, SUB-ASSOCIATION *SYRINGETOSUM JOSIKAEAE*

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Abstract

European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with Hungarian lilac (Syringa josikaea) in the Apuseni Mountains, Râmeţi Forest District, Management Unit (UP) IV Iadolina, compartments 93B, 95A, 95B, 96A, 108A were surveyed in terms of biodiversity and ecodiversity of phytocenoses of the association Pulmonario rubrae-Fagetum, the sub-association syringetosum josikaeae.

The analysis of the ecodiversity of the categories of bioforms, geoelements (elements of phytogeography), ecological indices (soil moisture, temperature, chemical reaction), the genetic categories by karytype highlights the fact that among the dominant bioforms specimens there are hemicryptophytes (54.52 %) followed by phanerophytes (25.20 %); in terms of elements of phytogeography spectrum the dominant species are the Eurasian (35.33 %) accompanied by European (17.44 %), Central European (12.76 %), Carpathian (9.30%), circumpolar (8.14 %), alpine (4.65 %) and endemites (4.65 %). In response to the environmental factors action (HTR) the beech, fir and spruce forests with Syringa josikaea show a mesophilic (58.08 %) to meso-hygrophilic (24.36%), a micro-mesothermal (46.50 %) to microterhmal (40.70 %), and an acido-neutrophilic (37.20 %) to weak acid-neutrophilic (27.84 %) behaviour, respectively. The cytogenetic analysis of the European beech-Silver fir stands with Hungarian lilac shows the dominance of the diploid species (51.16 %) closely followed by the poliploid species (40.69 %). They are virgin secular forests of high conservation value.

Key words: forest, beech, fir, spruce, genetic categories.

INTRODUCTION

European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with *Syringa josikaea* shrublet are hosted on crowded steep slopes (38-46°) with massive rocks and grooves covering 50 % of their surface, on the mountain floor at altitude ranging between 750-900 m, with predominantly Western orientation, crystalline schist rocks, superficial skeletal soils consisting of districambosoil, acido-neutrophilic, oligobasic, wet soils.

We selected to conduct a phytosociological and cytogenetic study on these forests, because within a critical habitat there is a rare natural forest ecosystem i.e. European beech-Silver fir (2,416), Norway spruce-European beech-Silver fir (2,316), and tertiary relic and Carpathian endemic species of *Syringa josikaea*.

There are virgin secular forests on very diverse layers with very high conservative value, and sheltering rare, endangered, threatened, endemic plant species which are relics declared as protected in a Botanical Nature Reserve contained in SCI, ROSCI0262 SITES.

Ecological genetics research on the beech (*Fagus sylvatica*), fir (*Abies alba*) and spruce (*Picea abies*) forests with *Syringa josikaea* did not take place before in the Apuseni Mountains, the Valea Iadului valley basin except for flora and vegetation carried out by Rațiu (1965, 1967), and Rațiu et al. (1984).

Contributions to the cenotaxa classification of *Syringa josikaea* shrublet were brought by Sanda et al. (1999) which subordinates the Hungarian lilac population to *Carici brizoides-Alnetum* or by Chifu et Irimia (2014) which subordinates it to *Telekio speciosae-Alnetum incanae*. Ecological genetics research on virgin beech forests mixed with coniferous forests has been carried out recently in Vlădeasa Massif by Burescu (2013, 2015, 2017).

In Romania, research on virgin and high conservation value forests was carried out by Abrudan et al. (2006), Bândiu and Doniță (1988), Bândiu et al. (2001), Biriş (2004), Biriş et al. (2005), Chifu and Ștefan (1992), Chifu et al. (2014), Doniță and Biriş (2001), Giurgiu (2001), Radu (2001), Stăncioiu et al. (2008).

MATERIAL AND METHOD

Study material consists of the beech (*Fagus sylvatica*) and fir (*Abies alba*) forests, the beech-coniferous (*Fagus sylvatica, Abies alba* and *Picea abies*) forests from the Valea Iadului basin, Management Unit (UP) IV Iadolina, Remeţi Forest District, compartments:

UA 93B, Dealul Mare hill, surface: 7.7 ha, altitude:750 m;

UA 95A, Iadolina waterfall, surface: 5.4 ha, altitude: 850 m;

UA 95B, Dealul Mare-Defileu hill-defile, surface: 13.0 ha, altitude: 860 m;

UA 96A, Iadolina waterfall, surface: 1.3 ha, altitude. 880 m;

UA 108A Calea Lăii area, at the base of the rocky slopes, surface: 22,7 ha, altitude: 900 m.

In the surveyed compartments we carried out a floral inventory and the plant species we found were recorded in the association table with the appreciation of abundance and dominance according to Braun-Blanquet cover-abundance scale (1964) and K-constant (frequency within territory).

European beech-Silver fir stand (*Fagus sylvatica, Abies alba*) and Norway spruce-European beech-Silver fir stand (*Fagus sylvatica, Abies alba, Picea abies*) with Hungarian lilac (*Syringa josikaea*) were analyzed ecologically, phytosociologically and cytogenetically on the basis of tables previously prepared highlighting the distribution of bioforms, the spectrum of the ecodiversity of the geoelements, the distribution of the ecoforms (moisture index, temperature, soil chemical reaction) and the distribution of the genetic categories in the phytocoenoses of the association *Pulmonario rubrae-Abieti-Fagetum-syringetosum josikaeae*. The classification of bioforms was made after Raunkiaer system (1937) improved by Braun-Blanquet cover-abundance scale (1964) and the classification of geo-elements was carried out after the classification of Meusel et Jäger (1992).

Analysis of the composition of the beech forests (*Fagus sylvatica*) mixed with fir (*Abies alba*), spruce (*Picea abies*) and Hungarian lilac (*Syringa josikaea*) into categories of ecoforms (ecological indices) was done after the works of Csűrös et al. (1967), Beldie, Chiriţă (1967), Sanda et al. (1983, 2003), which adapted the values of the ecological indices (UTR) for the Central European species on an Ellenberg scale indicators value ranging between 1 and 9 (1979) to the pedo-climatic conditions specific to our country using a scale of values between 1 and 6.

RESULTS AND DISCUSSION

The floral inventory of European beech-Silver fir stand, Norway spruce-European beech-Silver fir stand with *Syringa josikaea* shrublet at the base of the slopes, association *Pulmonaria rubrae-Abieti-Fagetum* consists of 86 species (see Table 1 below), of which three species i.e. *Pulmonaria rubra*, *Abies alba*, *Fagus sylvatica* are characteristic for this association and 58 species are differentiated for basic cenotaxa of the association i.e. *Symphyto-Fagenion, Symphyto cordati-Fagion* (9 species), *Alno-Ulmion, Alnenion* *glutinosae – incanae* (17 species), *Fagetalia sylvaticae* (17 species), *Querco-Fagetea* (15 species). A total of 15 species are transgressive from other associations i.e. class *Vaccinio-Picetea* (eight species), class *Betulo-Adenostylete* (seven species), which suggests a very high biodiversity.

The tree layer is dominated by *Fagus sylvatica* with an overall coverage rate of 40 %, *Abies alba* with an overall coverage rate of 16 %, *Picea abies* with an overall coverage rate of 6 %, alongside *Ulmus glabra, Acer pseudoplatanus, Sorbus aucuparia, Carpinus betulus, Betula pendula, Fraxinus excelsior, Pinus sylvestris*. The coagulation of tree crowning is 0.6, the trunk diameters range between 60 and 80 cm and height thereof reaches between 18 and 26 m at the age of 160 years.

The less developed shrub layer consists of *Syringa josikaea* with an overall coverage rate of 3.3 % accompanied by *Corylus avellana, Sambucus racemosa, Salix capraea, Daphne mezereum, Spiraea chamaedrifolia, Lonicera xylosteum, Lonicera nigra, Rosa pendulina,* and *Clematis alpina*

The herb layer with an overall coverage rate of 31 % is dominated by the next species: *Festuca drymeja, Pulmonaria rubra, Polystichum aculeatum, Athyrium filix-femina, Dryopteris filix-mas, Oxalis acetosella, Lamium galeobdolon, Rubus hirtus, Luzula luzuloides, Senecio germanicus, Asarum europaeum, Calamagrostis arundinacea, Doronicum austriacum, Stellaria nemorum, Galium odoratum, Mercurialis perennis, Petasites hybridus, Telekia speciosa*, etc.

European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand within the Valea Iadului valley contain a rare natural forest ecosystem placed in a critical, endemic habitat with a very high conservative value in which rare, endangered, endemic, relict species included on the red flag lists got refuge and have survived according to Boşcaiu et al. (1994), Oltean et al. (1994), Dihoru et Dihoru (1994), Sârbu coord. (2007), Mohan et Ardelean (2006), Dihoru and Negrean (2009) i.e. *Aconitum callibotrion* (Carphatian-Endemic), *Aconitum vulparia* (rare), *Angelica archangelica* (vulnerable), *Campanula rotundifolia* (rare), *Dryopteris cristata* (rare), *Phyteuma tetramerum* (Carphatian-endemic), *Syringa josikaea* (Carphatian-endemic and tertiary relic species in danger of extinction), *Trolius europaeus* (glacial relic, rare species), *Lilium martagon* (forest relic) *Clematis alpina* (rare), *Leucanthemum waldsteinii* (rare).

Besides the typical association in which the dominant edifiers are *Pulmonaria rubra, Fagus sylvatica, Abies alba,* in five phytocoenoses surveyed, *Syringa josikaea* is highlighted by abundance and dominance criteria with a coverage rate of 3.3 %.

This species together with 16 other differential species i.e. *Athyrium filix-femina, Senecio germanicus, Doronicum austriacum, Dryopteris cristata, Gentiana asclepiadea, Aconitum vulparia, Petasites hybridus, Telekia speciosa, Filipendula ulmaria, Angelica sylvestris* and others form compact communities which we classified in the sub-association *syringetosum josikaeae* subas.nova, (Table 1 rel. 1-5 below), holotype survey no. 2, subordinated to the basic association.

Table 1

The ecology of the European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand reunited in the Association *Pulmonario rubrae - Fagetum - syringetosum josikae* subas-nova. Holotype survey no. 2

Bio.	Geoelements	U T R (ecoforms)			2n (genetic karytype)	Surveys no.	1	2	3	4	5	K
						Compartments (u.a.) surveyed	Ua93B	Ua95A	Ua95B	Ua96A	Ua108A	
						Altitude (m)	750	850	860	880	900	
						Exposition	V	V	SV	V	V	
						Slope (°)	38	45	40	45	46	
						Tree height (m)	18	25	24	25	26	
						Tree diameter (cm)	60	80	80	60	80	
						Degree of canopy density	0.7	0.6	0,6	0.6	0,6	
						Herbal layer coverage (%)	35	20	40	20	40	
						Surface (ha)	7.7	5.4	13.9	1.3	22.7	
1	2	3	4	5	6	7	8	9	10	11	12	13
H	Carp-B	3.5	2	2	D	As. *Pulmonaria rubra*	.	+	+	+	+	IV
MPh	Ec	4	3	0	D	As. *Abies alba*	+	3	2	1	2	V
MPh	E	3	3	0	D	As. *Fagus sylvatica*	4	2	3	3	3	V
						Symphyto – Fagenion, Symphyto cordati - Fagion						
MPh	Ec	3.5	3	3	P	*Acer pseudoplatanus*	+	+	+	+	+	V
G-H	E-M	4	2	3	D	*Festuca drymeja*	2	+	2	.	2	IV
H	E	3.5	3.5	3.5	P	*Polystichum aculeatum*	+	+	+	+	+	V
G	End	4	2.5	4	P	*Dentaria glandulosa*	.	.	+	.	+	II
H-G	End	3	2	3	D	*Symphytum cordatum*	.	.	.	.	+	I
H	Carp-B	3	0	0	D	*Hieracium transsylvanicum*	.	.	.	+	.	I
H	Carp	4	2	3	D	*Leucanthemum waldsteinii*	.	+	.	.	.	I
H	E	3	3	3	D	*Hypericum montanum*	+	.	.	.	.	I
H	Carp-Ec	2.5	2.5	2.5	P	*Aconitum callibotrion*	.	.	.	.	+	I
						Alno-Ulmion, Alnenion glutinosae-incanae						
mPh	End	3.5	2.5	4	D	Subas. *Syringa josikaea*	+	1	1	+	1	V
H	Cosm	4	2.5	0	P	*Athyrium filix-femina*	1	+	+	1	1	V
H	Eua	3.5	3	3	P	*Senecio germanicus*	.	+	+	+	+	IV
H	Ec	3.5	2	3	P	*Doronicum austriacum*	.	+	.	+	+	III
H	E	3.5	3	3	D	*Stellaria nemorum*	+	+	+	.	.	III
G	Eua	4	0	0	P	*Petasites hybridus*	.	+	+	.	+	III
H	Carp-B-Cauc-Anat	4	2	0	D	*Telekio speciosa*	.	+	+	.	+	III
H	Cp	3.5	2	3	P	*Dryopteris cristata*	+	+	.	.	.	II
H	Ec	4	2	4	P	*Gentiana asclepiadea*	+	.	.	.	+	II
H	Eua	4	2	0	D,P	*Filipendula ulmaria*	+	.	.	.	+	II
H	Eua	3.5	0	4	D	*Silene dioica*	.	.	+	.	+	II
H	Ec	4	2.5	4	D	*Aconitum vulparia*	.	+	.	+	.	II
MPh	E	4	2	4	P	*Alnus incana*	+	.	.	.	.	I
G	Ec	3.5	3	2	P	*Carex brizoides*	+	.	.	.	.	I
MPh	E	3	3	4	D	*Fraxinus excelsior*	+	.	.	.	.	I

Table 1 (continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
H	Eua	4	3	3	D	*Angelica sylvestris*	+	.	.	.	.	I
H(Ch)	Eua	3.5	3	4	D	*Lamium maculatum*	+	.	.	.	.	I
						Fagetalia sylvaticae						
H-G	Cp	4	3	3	D	*Oxalis acetosella*	+	+	+	+	+	V
H-Ch	Ec	3	0	4	D	*Lamium galeobdolon*	+	+	1	1	+	V
nPh	Eua	3	2.5	3	P	*Rubus hirtus*	+	+	+	+	1	V
H-G	Eua	3.5	3	4	D	*Asarum europaeum*	+	+	1	+	.	IV
G	Eua	3	3	0	P	*Galium odoratum*	+	+	+	.	+	IV
H-Ch	Alp-B	0	3	4	P	*Mercurialis perennis*	+	+	+	.	.	III
Th-TH	Cosm	3.5	3	3	P	*Geranium robertianum*	+	+	+	.	.	III
G	Ec	3	3	3	P	*Symphytum tuberosum*	+	.	.	.	+	II
H	Eua	3.5	3	4	D	*Sanicula europaea*	.	+	+	.	.	II
H	Eua	3	0	3.5	P	*Epilobium montanum*	.	+	+	.	.	II
H	Eua	3.5	3	4	D	*Salvia glutinosa*	.	+	+	.	.	II
H	Eua	3	2.5	0	D	*Fragaria vesca*	.	+	+	.	.	II
Th	E	2.5	3	2	P	*Galeopsis tetrahit*	.	+	.	.	+	II
G	Eua	3	0	4	D	*Lilium martagon*	+	.	.	.	.	I
G	Cp	3	2.5	2	P	*Gymnocarpium dryopteris*	.	.	.	.	+	I
G	Eua	3	2.5	2.5	D	*Polygonatum verticillatum*	.	.	.	+	.	I
nPh	Eua	3.5	3	3	D	*Daphne mezereum*	+	.	.	.	.	I
						Querco - Fagetea						
MPh	Eua	4	3	3	P	*Ulmus glabra*	+	+	+	+	+	V
H	Cosm	4	3	0	P	*Dryopteris filix-max*	+	+	+	+	+	V
mPh	Balc	3	3	3	D	*Corylus avellana*	+	+	+	.	+	IV
MPh	Eua	3	2	2	P	*Betula pendula*	.	+	.	+	.	II
mPh	Eua	3	2.5	0	P	*Spiraea chamaedrifolia*	.	+	.	+	.	II
H(G)	Eua	3	0	4	D	*Melica nutans*	+	+	.	.	.	II
MPh	E	3	3	3	P	*Carpinus betulus*	+	.	+	.	.	II
H	E	4	3	4	D	*Lunaria rediviva*	.	.	+	.	.	I
H	E	3	3	3	D	*Mycelis muralis*	.	.	+	.	.	I
mPh	Eua	3	3	4	D,P	*Salix capraea*	.	+	.	.	.	I
H	Ec	2.5	3	3	P	*Digitalis grandiflora*	.	+	.	.	.	I
H	Eua	3	3	0	D	*Campanula persicifolia*	.	+	.	.	.	I
H	Cp	3	3	0	D,P	*Poa nemoralis*	.	+	.	.	.	I
G	Ec	2.5	3	3	P	*Galium schultesii*	.	+	.	.	.	I
mPh	Eua	3	3	4	D	*Lonicera xylosteum*	.	.	.	+	.	I
						Vaccinio – Piceetea						
H	E	2.5	2.5	2	D,P	*Luzula luzuloides*	+	+	+	.	+	IV
MPh	E	0	0	0	D	*Picea abies*	.	1	+	2	1	IV
MPh	E	3	2.5	2	D	*Sorbus aucuparia*	.	+	.	+	+	III
MPh	Eua	0	0	0	D	*Pinus sylvestris*	.	+	.	+	.	II
mPh	Alp(E)	3	2	3	D	*Lonicera nigra*	.	+	.	+	.	II
nPh	Ec	3	2.5	3	P	*Rosa pendulina*	+	.	.	+	.	II

Table 1 (continuation)

1	2	3	4	5	6	7	8	9	10	11	12	13
l-nPh	Arct-Alp-E	3	2	2	D	*Clematis alpina*	.	.	.	+	.	I
						Betulo – Adenostyletea						
G	Alp-Carp-B	3.5	2	3.5	P	*Doronicum columnae*	+	+	+	.	.	III
G	Eua	5	3	3	P	*Petasites hybridus*	.	+	+	.	+	III
H	Carp-B-Cauc-Anat	4	2	0	D	*Telekia speciosa*	.	+	+	.	+	III
H	Alp-Carp-Balc	2.5	3	4	P	*Achillea distans*	+	.	.	.	.	I
TH-H	Eua-Bo	4.5	2.5	0	D	*Angelica archangelica*	.	.	.	.	+	I
H	Eua	4	2.5	0	D	*Heracleum sphondilium*	.	.	.	+	.	I
H	Carp-B	4	2	4	D	*Trolius europaeus*	+	.	.	.	.	I
						Variae syntaxa						
G	Cp	3.5	3	4	P	*Polypodion vulgare*	.	+	+	.	.	II
G	Eua(M)	2	3	4	D	*Polygonatum odoratum*	+	.	.	.	.	I
H	Carp	2.5	2	0	D-P	*Campanula rotundifolia* ssp. *kladniana*	.	+	.	.	.	I
H	Cosm	3	0	4	D	*Asplenium trichomanes*	.	+	.	.	.	I
H	Cp	2.5	2	3	D	*Solidago virgaurea*	.	+	.	.	.	I
H	E	2.5	3	5	D	*Melittis melissophyllum*	.	.	.	.	+	I
H	Eua	4	3	3	D,P	*Eupatorium cannabinum*	.	+	.	.	.	I
H	Eua	3.5	3	0	P	*Molinia caerulea*	+	.	.	.	.	I
mPh	Cp	3	2	3	P	*Sambucus racemosa*	.	+	.	.	.	I
H	End.	3	2.5	3	C,N	*Phyteuma tetramerum*	+	.	.	.	.	I

Place and date of surveying: compartament UA 93B – Dealu Mare hill, behind the forest range (canton): 27.08.2012;
Compartment UA 95A - Iadolina waterfall on Valea Iadului valley: 27.08.2012; Compartment UA 95B – Dealu Mare hill upstream of forest range: 27.08.2012; Compartment 96A UA - Iadolina waterfall: 27.08.2012; Compartment UA
108A – Calea Lăii on Valea Iadului valley: 27.08.2012.

Analysis of European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with Hungarian lilac (*Syringa josikaea*) from the upper basin of Valea Iadului valley in Apuseni Mountains show that in the bio-diversity spectrum of bioforms (live forms) the dominant species are: hemi-cryptophytes (54.52 %) followed by the phanerophytes (25.20 %) of which: (MPh=12.76 %, mPh=8.12 %, nPh=3.18 %, l-nPh=1.16 %) geophytes (16.47 %) and therophytes (3.52 %) are the species best adapted to a temperate-continental climate (Table 2).

Table 2

European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with *Syringa josikaea* in the Apuseni Mountains, Management Unit IV Iadolina, Remeţi Forest District.

Bioforms	Ph of which:				H	G	T		Total species
	MPh	mPh	nPh	l-nPh			TH	Th	
No. species	11	7	3	1	47	14	2	1	86
Percentage %	12.76	8.12	3.48	1.16	54.52	16.27	2.32	1.16	100

Legend: Ph=phanerophytes (woody plants); MPh=mega-phanerophytes; mPh=meso-phanerophytes; nPh=nano-phanerophytes; l-nPh=climbing plants; T= therophytes; TH=bi-annual therophytes; Th=annual therophytes.

When analyzing the genetic centre of origin and the current geographical area of the species European beech-Silver fir stand with Hungarian lilac shrublet it is clear that bulk of geoelements is dominated by the Eurasian species (35.33 %) closely followed by the European species (17.44 %), Central European (12.76 %), and at a long distance by Carpathian (9.30 %), circumpolar (8.22 %), alpine (4.65 %), arctic (1.16 %), Balkan (1.16 %), endemic (4.65 %) and cosmopolite (4.65 %) species (Table 3); this phenomenon may be explained by the pedo-climatic conditions of the vegetation habitat and the floral ties with the Southern and Eastern Carpathians.

Table 3

Ecodiversity of geolements in the European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with *Syringa josikaea* in the Apuseni Mountains, Management Unit IV Iadolina, Remeţi Forest District.

Geoelements	Eua	E	Ec	Cp	Carp	Balk	Alp-Carp-Balk.	Arct.	End	Cosm	Total species
No. species	31	15	11	7	8	1	4	1	4	4	86
Percentage %	35.33	17.44	12.76	8.14	9.30	1.16	4.65	1.16	4.65	4.65	100

Legend: Eua=Eurasian; E=European; Ec=Central European; Cp=circumpolar; Carp=Carpathian; Alp-Carp-Balk=Alpine-Carpathian-Balkan; Balk=Balkan; Arct=Arctic; End=endemic; Cosm=cosmopolite; geoelem.=geoelement or phytogeographical element.

Analysis of ecoforms (ecological indices) - see Table 4 - shows that European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with *Syringa josikaea* in terms of moisture show a mesophilic behaviour (58.08 %), and a meso-hygrophilic (24.36 %) to slightly xero-mesophilic (12.66 %) behaviour. The temperate-continental climate and the habitat characteristic for the mountain forests in the Valea Iadului valley, Apuseni Mountains (see Table 4 below) stimulates the development of micro-mesothermal species (46.50 %), micro-thermal (40.70 %), euri-thermal (11.60 %) species.

In terms of soil chemical reaction (Table 4) the most important species are acid-neutrophilic (37.20%), weak acid-neutrophilic (27.84%), euryionic (23.20%) and acidophilic (10.34%) species.

The distribution of the genetic categories by karytype (Table 5) in the phytocoenoses of the association *Pulmonario rubrae-Abieti-Fagetum*-sub-association *syringetosum josikaeae* reveals the dominance of diploid species (51.76 %) containing the gene reserve required for evolution, followed by polyploidy (41.17 %) endowed with genes that favour the colonization of the land and adaptation to the environmental conditions imposed by the habitat of the very steep slopes with surface rocks and grooves subjected to the action of strong winds, heavy snow and low temperatures.

Table 4

Distribution of ecoforms (ecological indices HTR) in the phytocenoses of European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand in the Apuseni Mountains. Association *Pulmonario rubrae - Fagetum, - syringetosum josikaeae* subas. nova.

Ecological indices	Value categories	2	2.5	3	3.5	4	4.5	5	0	Total species
H	No. species Percentage %	2 2.32	9 10.34	31 36.04	19 22.04	20 23.20	1 1.16	1 1.16	3 3.48	86 100
T	No. species Percentage %	19 22.09	16 18.61	40 45.34	1 1.16	- -	- -	- -	10 11.60	86 100
R	No. species Percentage %	9 10.34		32 37.20		24 27.84		1 1.16	20 23.20	86 100

Legend: H=humidity (moisture); H(2-2.5)=xero-mesophiles; H(3-3.5)=mesophiles; H(4-4.5)= meso-higrophiles; H(5)=hygrophila; H(0)=eurhydra; T(2-2.5)=micro-thermal; T(3-3.5)=meso-thermal; T(0)=eury-thermal; R(2)=acidophilic; R(3)=acid-neutrophilic; R(4)=weak acid-neutrophilic; R(5)= neutro-basifying; R(0)=euryionic.

Table 5

Distribution of genetic categories by karytype (diployds, polyploids, diplo-polyploids) in the phytocoenoses of the European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand from the Apuseni Mountains. Association *Pulmonario rubrae-Fagetum-syringetosum josikae* subas. nova.

Genetic categories	Diploids (D)	Polyploids (P)	Diplo-Polyploids (DP)	Unknown karytype UK	Total species
No. species	4.4	35	6	1	86
%	51.16	40.69	6.97	1.16	100

Importance

The European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with Hungarian lilac are included in or include natural habitats of community interest i.e. Habitat 4104-South-Eastern Carpathian beech forests (*Fagus sylvatica*) and fir forests (*Abies alba*); Habitat 4101-South-Eastern Carpathian spruce forests (*Picea abies*), beech forests (*Fagus sylvatica*) and fir forests (*Abies alba*) with *Pulmonaria rubra*, with Hungarian lilac shrublet-*Syringa josikaea*, endemic, tertiary relict, endangered species at risk of becoming extinct which must be protected by declaring conservation areas, Doniță et al. (2005), Gafta, Mountford coord. et al. (2008). There are virgin secular forests included in Class I i.e. forest vegetation with special protection functions, categories 1.5c, 1.5j, 1-5i, 1-5e, 1-2a, 1-2c playing an important role in the control of soil erosion, protection of hydrographical basins and water capture, and in climate control. Although important for the wood industry, any kind of tree cuts that are likely to affect the fragile stability of the rocks and talus of the steep slopes are forbidden in these forests.

Only special conservation works will be carried out to ensure the persistence and protection within the ecosystem of the rare, endangered, endemic, relict species and the natural regeneration of forest species through seeds.

CONCLUSIONS

1. A total of 86 species of plants were identified through our research, which means high biodiversity and ecological diversity, of which 11 species are rare, endangered, vulnerable, some extinct, endemic, relict species for the protection of which declaring the areas as protected natural areas is required.

2. European beech-Silver fir stand and Norway spruce-European beech-Silver fir stand with *Syringa josikaea* are dominated by hemi-cryptophytes (54.52 %), consequence of the belonging of the geographic area surveyed to the temperate-continental climate specific in Apuseni Mountains. Although fewer (25.20 %), phanerophytes are the species which instil the physiognomy of beech forests mixed with coniferous, fir, spruce and *Syringa josikaea*.
3. In terms of geographical area, the genetic centre of origin for the geoelements background consists of Eurasian (35.33 %), European (17.44 %), Central European (12.76 %), Carpathian (9.30 %), circumpolar (8.14 %), alpine (4,65 %), endemic (4.65 %), cosmopolite (4.65 %) species, followed at a distance by Balkan (1.16 %) and arctic (16 %) species.
4. The analysis of ecoforms in response to the action of ecological factors (i.e. moisture, temperature, chemical reaction of the soil) reveals the mesophylic (58.08 %), meso-hygrophilic (24.36 %), micro-mesothermal (46.50 %), micro-thermal (40.70 %), acid-neutrophilic (37.20 %), to weak acid-neutrophilic (27.84%) species of beech, fir, spruce forests with *Syringa josikaea*.
5. Cytogenetic analysis shows that in the phytocenoses of European beech-Silver fir stand with Hungarian lilac the diploid species (51.16 %) are dominant and such species store the gene reserve necessary for the evolution of the species followed by polyploids (40.69 %) which favour the adaptation to the pedo-climatic conditions during the colonisation of geographical area.
6. Based on the Association table and the characteristic and differential species, we separated a new sub-association i.e. *syringetosum josikaeae* subas. nova, which we subordinated to the basic association *Pulmonario rubrae-Fagetum*.

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