J. Plant Develop.
20(2013): 79 – 103

VARIATION OF MACROMYCETES SPECIES COMPOSITION IN TWO FOREST HABITATS FROM GIUMALĂU MASSIF (EASTERN CARPATHIANS, ROMANIA)

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Abstract: Norway spruce (*Picea abies*) is the most common species with a large spreading in forests from Giumalău Massif. In this study the authors investigated the macromycetes species composition in two forest communities from Giumalău Massif: *Hieracio transsilvanico-Piceetum* and *Leucanthemo waldsteinii-Fagetum*. A total of 243 macromycetes species in 30 sampling areas have been identified. Changes in macromycetes species composition have been related to environmental factors (altitude) and vegetation (canopy cover, plant species diversity). The results suggest that variation in macromycetes species composition in the two forests types from Giumalău Massif is directly related to abiotic factors (altitude), woody species composition and plants communities' structure.

Keywords: altitude, fungi, diversity, tree species, vegetation, Giumalău Massif.

Introduction

Fungi represent a vast group of heterotrophic organisms as their global diversity is estimated at over than 1.5 million species, presenting very different structural organization and adapted to almost all ecosystems types [HAWKSWORTH, 1991]. Among all these species, the fungi from forests are considered to have the highest diversity within all ecosystems. Also, the fungi have major roles in forest ecosystem including: nutrient cycles, forming and keeping soil structure, food source in trophic chain for detritivores, mycorrhizal symbiosis [WIENSCZYK & al. 2002] etc.

In temperate zones, several studies have found that abundance and macromycetes diversity are related to plants species and microenvironment [GOMEZ-HERNANDEZ & WILLIAMS-LINERA, 2011]. Also, the spatial distribution of saprophytic fungi is associated with substratum and it is usually more uniform than mycorrhizal fungi distribution [LAGANÀ & al. 1999]. Spatial distribution of saprophytic fungi is associated with the substratum and usually is more uniform than mycorrhizal fungi. However, many saprophytic fungi prefer a particular tree or shrub species [ROBERTS & al. 2004]. Fungal communities are strongly influenced by vegetal community composition, structure and age because of its closed relationship with trees and soil nutrients [KÜFFER & SENN-IRLET, 2005].

From this reason, there is an interest in studying of macromycetes distribution depending on forest species composition. Vegetation structure and plant species composition varies depending on the environmental conditions and their fluctuation

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influences macromycetes community. The relationship between trees and fungal communities depend on host-tree species which influence fungi specialization and provide unique habitats [LAGANÀ & al. 1999]. All these are depending on environmental factors [GOMEZ-HERNANDEZ & WILLIAMS-LINERA, 2011]. Geomorphological features (as slope, aspect and altitude) seem to influence macromycetes communities. On the other way, the climatic and microclimatic conditions depend on altitude; anyway, changes of macromycetes species composition and diversity due to altitude have been barely investigated. Recent researches concluded that rainfall, humidity and temperature are the main factors influencing the appearance of sporocarps [GOMEZ-HERNANDEZ & WILLIAMS-LINERA, 2011]. In addition, richness and abundance of macromycetes species are related to microclimatic conditions. The results suggest that variations of humidity, precipitations and temperature are the most important factors influencing sporocarps production and macromycetes diversity [LAGANÀ & al. 2002].

In this study we investigated macromycetes species composition in two forests communities from Giumalău Massif: *Hieracio transsilvanico-Piceetum* Pawlowski et Br.-Bl. 1939 where the trees layer is almost totally edified by Norway spruce (*Picea abies*) and *Leucanthemo waldsteinii-Fagetum* (Soó, 1964) Taüber 1987 where the trees layer is co-dominated by spruce (*Picea abies*) and beech (*Fagus sylvatica*) with sporadically appearences of fir (*Abies alba*), birch (*Betula pendula*) and maple-mountain (*Acer pseudoplatanus*). Also we tried to detect if altitude, slope, canopy cover and plants species diversity could influence the macromycetes species composition.

Materials and methods

The studied area represents a small region of the Eastern Carpathians from Romania situated at the intersection of the following geographical coordinates: 47°25' N and 25°25' E. It has a total area of about 213 km^2 and is rhomboidal shaped (Fig. 1). The mountain relief presents medium altitudes varying between 1100-1200 m. Geological substratum belongs to the crystalline block and pedological coating is included into the following classes: cambisoils, spodosoils, litomorphic and undeveloped soils. The Giumalau Massif is characterized by a continental climate presenting excessive nuances, with differentiations determined by altitude, mountainous depressions and corridors [LESENCIUC, 2006].

The investigations in sampling areas (which had 1000 m^2 in size) have been realized from May to October during three consecutive years. A total of 30 observations have been performed as follows: relevés R01 - R15 for surfaces of *Hieracio transsilvanico-Piceetum* association and relevés F16 - F30 for surfaces of *Leucanthemo waldsteinii-Fagetum* association. The macromycetes species from inside of investigated areas have been identified „*in situ*", if that has been possible. Sporocarps of unidentified species were investigated through laboratory specific methods based on micromorphological and macromorphological characters according to keys and reference guides [BORGARINO & HURTADO, 2001; BREITENBACH & KRÄNZLIN, 1984, 1986, 1991; COURTECUISSE & DUHEM, 1994; ROUX, 2006; SĂLĂGEANU & SĂLĂGEANU, 1985; ŞESAN & TĂNASE, 2006; TĂNASE & ŞESAN, 2006]. We defined macromycetes as visible fungi which produce sporocarps with a diameter larger than 5 mm. The scientific names (current names) have been updated according to *The Index Fungorum* database. The collected macromycetes species have been classified into functional groups based on their primary nutrition mode as following: saprophytic, mycorrhizal and parasitic. Functional groups used are slightly arbitrary because it is well known that many fungi can switch between these functional groups, depending on environmental conditions. Some saprophytic decomposing species can also function as a weak parasite species (e.g. *Armillaria mellea*). However, analysis of diversity for the functional groups is still an interesting subject because it may highlight some differences between macrofungal communities from different types of forests.

For vegetation analysis, a set of 30 relevés (1000 m^2) with phytosociological data collected in the same time with those referring to macromycetes has been realized. Vegetation sampling has been made according to the standard Central European Phytosociological Method [BRAUN-BLANQUET, 1964]. The hierarchical agglomerative clustering has been realized using the GINKGO software [DE CÁCERES, 2003]. In this application we created a rectangular matrix where the mid-percentages values of the 6 degrees Braun-Blanquet scale have been inserted. These mid-percentages values were square-root transformed and used to create a similarity matrix using Jaccard index as resemblance measure. Agglomerative hierarchical clustering has been realized using the UPGMA algorithm. The phytosociological nomenclature, classification [COLDEA, 1991; CHIFU & al. 2006] and cormophytes nomenclature [CIOCÂRLAN, 2000] followed some prestigious works in this domain. For each vegetal association, chorology, floristic and phytosociological composition are presented.

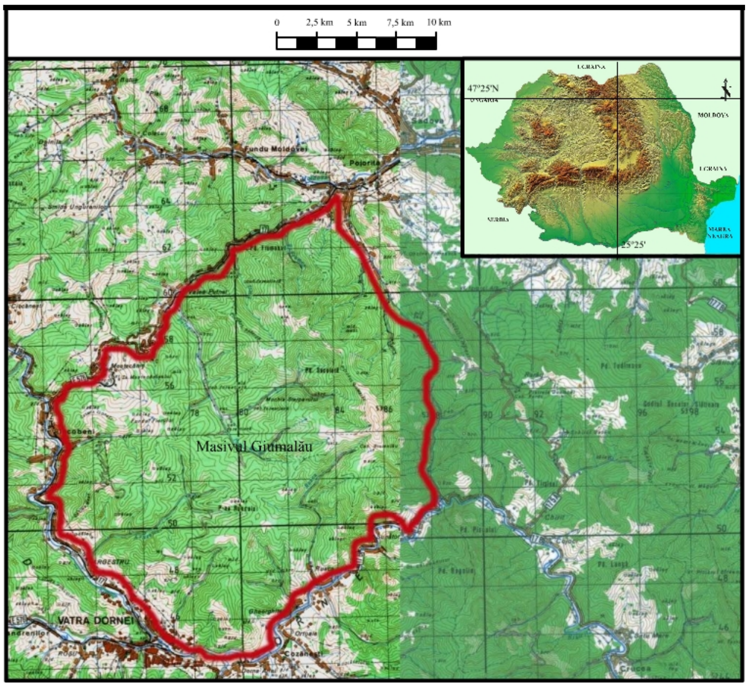

Fig. 1. Geographical position of Giumalău Massif

Macrofungal similarity of investigated areas was estimated based on Jaccard Index which evaluates similarity and matching between species [VARVARA & al. 2001] in different sites. Their hierarchical agglomerative clustering of has been also realized using the GINKGO software [DE CÁCERES, 2003], on presence-absence data using Jaccard Index as resemblance measure and the UPGMA clustering algorithm. For each sample area, geographical coordinates and altitude were recorded using a geographic positioning device (GPS II Plus Garmin Ltd.). The slope was measured with a clinometer and the exhibition was determined using a compass.

Detrended Correspondence Analysis (DCA) has been realized in order to distinguish the main gradients in macromycetes species composition and to characterize them from an ecological perspective. Detrending by segments and non weighted average values of altitudes, slopes, trees canopy covering and diversity (as Shannon indices) for each relevés were used (as passive projected variables). DCA has been realized in CANOCO 4.5 [TER BRAAK & ŠMILAUER, 2002].

Results and discussion

In the forest communities of Giumalău Massif have been identified 243 species of macromycetes from 30 sample areas. In *Hieracio transsilvanico-Piceetum* association have been identified 162 macromycetes species. They were identified on the following substrate types: soil, wood, animal excrements, and Norway spruce cones. In *Leucanthemo waldsteinii-Fagetum* association 120 macromycetes species have been identified. Approximately 16% of macromycetes species were common taxa. It was also observed that maximum development of sporocarps collected within investigated areas is clearly registered in August and September with more than 50% of identified species.

Phytocoenosis from *Hieracio transsilvanico-Piceetum* Pawlowski et Br.-Bl. 1939 association are frequently found all around in Giumalău Massif areas (Mestecăniş, Giumalău Secular Forest, Bâtca Neagră, Rusca, etc.), where they are populating more or less accentuated slopes (10-50°), with various aspects, on acid soils, poor in nutrients. Trees layer is dominated by Norway spruce (*Picea abies*) realizing a cover percentage between 75% and 95%, with lower proportions of *Sorbus aucuparia*, *Abies alba*, *Fagus sylvatica*, *Betula pendula* and *Acer pseudoplatanus*. Shrub and regeneration layer presents a low covering between 3% and 15%. In its composition have been identified more frequently the following species: *Vaccinium myrtillus*, *Vitis vitis-idaea*, *Daphne mezereum*, *Rubus idaeus*, *Sambucus racemosa*, *Corylus avellana*, *Lonicera xylosteum*, together with *Picea abies*, *Abies alba* and *Sorbus aucuparia* seedlings. Herbaceous layer is the most diverse, it presents different coverages between 10% and 70% and includes characteristic species for *Piceion excelsae* alliance, *Piceetalia excelsae* order (*Melampyrum sylvaticum*, *Luzula luzuloides*, *Gymnocarpium dryopteris*, *Calamagrostis villosa*, *Deschampsia flexuosa* etc.), *Vaccinio-Piceetea* class (*Oxalis acetosella*, *Campanula abietina*, *Homogyne alpina*, *Orthilia secunda* etc.) and also species characteristic for other vegetation classes interferring with the spruce stands: species of deciduous or mixed forests typical for *Querco-Fagetea* class (*Pulmonaria rubra*, *Euphorbia amygdaloides*, *Lilium martagon*, *Athyrium filix-femina*, *Mycelis muralis* etc.), characteristic species for forest clearings from *Epilobietea angustifolii* class (*Senecio ovatus*, *Fragaria vesca*, *Galeopsis speciosa* etc.), or for *Mulgedio-Aconitetea* class (*Polygonatum verticillatum*, *Hypericum maculatum* etc.). According to the classification from The Habitats Directive, these phytocoenoses belong to **9410** type - Acidophilous spruce forests (*Picea*) from mountain to alpine zones.

Analysis of ecological categories of *Hieracio transsilvanico-Piceetum* association revealed predominance of mycorrhizal species of following genera: *Amanita, Boletus, Cantharellus*, *Chalciporus*, *Cortinarius*, *Elaphomyces*, *Gomphidius*, *Hydnum*, *Hygrophorus*, *Inocybe*, *Lactarius*, *Leccinum*, *Neolecta*, *Paxillus*, *Porphyrellus*, *Russula*, *Sarcodon*, *Thelephora* and *Tricholoma*. Among these 68 mycorrhizal species, many of them are characteristic for coniferous forests, and they are associated mainly with spruce: *Amanita regalis*, *Amanita spissa*, *Boletus badius*, *Cortinarius caperatus*, *Cortinarius sanguineus*, *Cortinarius semisanguineus*, *Elaphomyces granulatus*, *Gomphidius glutinosus*, *Hygrophorus agathosmus*, *Hygrophorus olivaceoalbus*, *Hygrophorus persicolor*, *Lactarius deterrimus*, *Lactarius picinus*, *Lactarius salmonicolor*, *Lactarius scrobiculatus*, *Leccinum piceinum*, *Neolecta vitellina*, *Porphyrellus porphyrosporus*, *Russula badia*, *Russula integra*, *Russula queleti*, *Sarcodon imbricatus*, *Tricholoma subannulatum*, and *Tricholoma vaccinum*. Besides these species, there have been identified other species that have not specificity for this habitat type, but they prefer coniferous forests. In this category, it should be mentioned species from *Amanita* genus (*Amanita battarrae*, *Amanita muscaria), Boletus* genus (*Boletus calopus*, *Boletus chrysenteron*, *Boletus edulis*, *Boletus erythropus*, *Boletus luridus*, *Boletus pulverulentus*, and *Boletus subtomentosus*) and *Russula* genus (*Russula aeruginosa*, *Russula delica*, *Russula foetens*, *Russula fragilis* var. *fragilis*, *Russula nigricans*, and *Russula ochroleuca*).

In the epixylous synusiae have been identified 43 species: saprophytes (32 species), saproparasites (10 species) and parasite (1 species). Of these some colonize exclusively coniferous wood, especially spruce: *Amylostereum areolatum*, *Calocera viscosa*, *Clitocybula lacerata*, *Dacrymyces stillatus*, *Gloeophyllum abietinum*, *Gloeophyllum odoratum*, *Gloeophyllum sepiarium*, *Gymnopilus penetrans*, *Hericium alpestre*, *Heterobasidion annosum*, *Hydnellum geogenium*, *Hypholoma capnoides*, *Mycena epipterygia*, *Pholiota astragalina*, *Pseudohydnum gelatinosum*, *Sparassis crispa*, *Spongipellis borealis*, *Tremella encephala*, *Trichaptum abietinum*, *Tricholomopsis decora*, *Tricholomopsis rutilans, and Xeromphalina campanella*. In the spruce woods, there was registered several species which frequently occurred in deciduous forests. Among them, we mention: *Armillaria ostoyae*, *Fomitopsis pinicola*, *Ganoderma applanatum*, *Hypholoma fasciculare* and *Pleurotus dryinus* (Tab. 1). Sporadic presence of deciduous species (*Sorbus aucuparia*, *Fagus sylvatica*, *Sambucus racemosa*, *Acer pseudoplatanus* and *Lonicera xylosteum*) is a support for lignicolous macromycetes with affinity for this kind of wood. Thus, on decidous wood debris (stumps, fallen branches) were identified following species: *Calocera cornea*, *Chlorociboria aeruginascens*, *Micromphale foetidum*, *Pholiota adiposa*, *Piptoporus betulinus*, *Stereum gausapatum*, *Stereum hirsutum*, *Trametes hirsuta*, *Tremella foliacea* and *Tubaria furfuracea*. Compared to the total number of macromycetes species of *Hieracio transsilvanico-Piceetum* association, lignicolous macrofungi represent 26.5%. This is explained by the higher amount of dead wood, especially in protected area from Giumalău Secular Forest (Fig. 4).

On fallen spruce cones, which are partially buried in soil, sporocarps from three macromycete species have been found: *Baeospora myosura*, *Rutstroemia bulgarioides* and *Strobilurus esculentus*. Foliicolous macromycetes are represented by three species identified on spruce needles: *Gymnopus perforans*, *Marasmius androsaceus* and *Mycena rosella*.

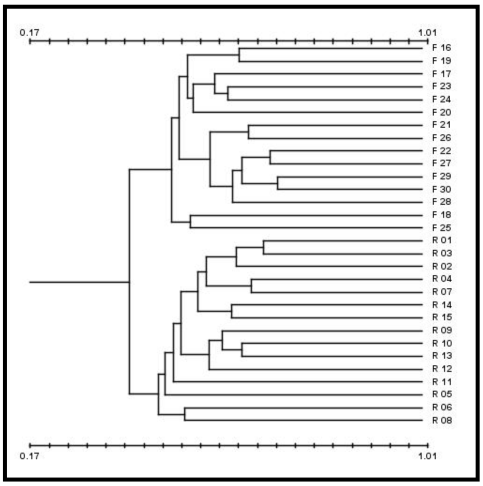

Fig. 2. Dendrogram of vegetation agglomerative hierarchical clustering (*Hieracio transsilvanico* and *Leucanthemo waldsteinii-Fagetum*)

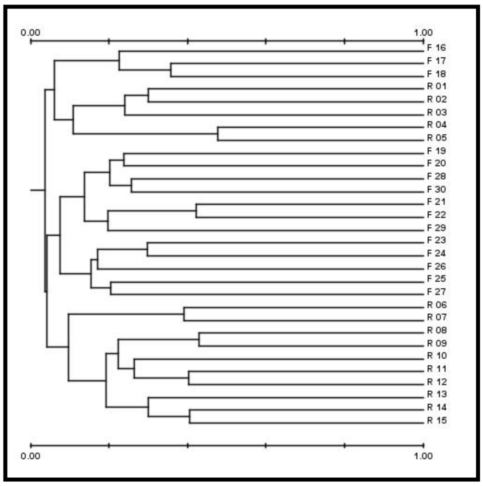

Fig. 3. Dendrogram of agglomerative hierarchical clustering of macromycetes from *Hieracio transsilvanico-Piceetum* and *Leucanthemo waldsteinii-Fagetum* associations

In Giumalău Massif, beech and spruce mixed forests (sometimes, they could be mixed with fir, but in reduced ratios) are included within *Leucanthemo waldsteinii-Fagetum* (Soó, 1964) Taüber 1987 association, from a phytosociological point of view. They are found at altitudes varying between 897 and 1200 m, on inclined slopes (15-45^o), with different aspects, on acid soils, richer in humus and nutrients than spruce fir forests. The trees layer has a good coverage, consisting of *Fagus sylvatica* (beech) and *Picea abies* (spruce), that are found in relatively equal proportions (co-dominant). In some phytocoenoses, they are accompanied by *Abies alba*, but with a relatively low proportion. Besides co-dominant species, within tree layer can also be found the following species: *Sorbus aucuparia*, *Betula pendula*, *Acer pseudoplatanus*, *Tilia cordata* etc. Shrub layer is relatively species poor with coverage between 3% and 5%. In this area, most common are following species: *Sambucus racemosa*, *Rosa pendulina*, *Rubus idaeus*, *Corylus avellana*, *Vaccinium myrtillus* and juveniles of *Fagus sylvatica*, *Picea abies*, *Abies alba* or *Sorbus aucuparia*. The herbaceous layer has a high diversity, presents coverages between 10% and 40% and includes characteristic species for *Symphyto cordati-Fagion* alliance (*Symphytum cordatum*, *Aconitum moldavicum* etc.), *Fagetalia sylvaticae* order (*Lamium galeobdolon*, *Actaea spicata*, *Epilobium montanum*, *Salvia glutinosa* etc.) and *Querco-Fagetea* class (*Dryopteris filix-mas*, *Viola reichenbachiana*, *Poa nemoralis* etc.). In the floristic composition there are also species characteristic for other vegetation classes: for coniferous forest species typical for *Vaccinio-Piceetea* class (*Dryopteris dilatata*, *Hieracium transsilvanicum* etc.) or species characteristic for forest clearings from *Epilobietea angustifolii* class (*Stachys sylvatica*, *Fragaria vesca* etc.). According to classification from

The Habitats Directive, these belong to habitat type **91V0** – Dacian Beech forests (*Symphyto-Fagion*).

In *Leucanthemo waldsteinii-Fagetum* association, 120 macromycetes species have been identified. Depending on ecological categories analysis, there where observed a predominance of lignicolous species with 59 species as follows: saprophytic (42 species), saproparasites (15 species) and parasitic (2 species). Saprophytic species were observed mainly on beech wood (stumps, fallen trunks, dry or rotten branches). Regarding to specificity depending on wood type where they are growing, most of identified species are oligophagous (they have not a strictly affinity based on substrate type – they were been identified on various kind of deciduous trees: beech, birch, alder and maple). Among monophagous species, they were observed only *Piptoporus betulinus* (on birch wood) and *Cytidia salicina* (on willow wood). Also, among polyphagous species that develops both on hardwood and softwood within this association, there have been identified: *Armillaria ostoyae*, *Crucibulum laeve*, *Fomitopsis pinicola*, *Hypholoma fasciculare*, *Merulius tremellosus and Pluteus cervinus*. Investigations on studied areas concerning to this macromycete category revealed a numerical superiority for species from *Trametes* and *Xylaria* genera (with 3 species); *Armillaria*, *Auricularia*, *Hypholoma*, *Polyporus* genera (with 2 species). Among genera with one single species identified in this association we mentioned: *Ascocoryne*, *Bisporella*, *Bjerkandera*, *Bulgaria*, *Chlorociboria*, *Chondrostereum*, *Crucibulum*, *Cyathus*, *Cytidia*, *Daldinia*, *Exidia*, *Flammulina*, *Fomes*, *Fomitopsis*, *Hericium*, *Hypoxylon*, *Kretzschmaria*, *Merulius*, *Mycena*, *Nectria*, *Oudemansiella*, *Panellus*, *Phlebia*, *Pholiota*, *Lycoperdon*, *Piptoporus*, *Pleurotus*, *Plicaturopsis*, *Pluteus*, *Pseudoclitocybe*, *Pycnoporus*, *Sarcoscypha*, *Schizophyllum*, *Stereum*, *Tremella*, and *Xerula*. Compared with total number of macromycetes species from the *Leucanthemo waldsteinii-Fagetum* association, lignicolous macromycetes percentage is 49% (Fig. 4). Significant amount of dead wood in the forest phytocoenosis favored development of this macromycetes ecological category.

Among of these 19 mycorrhizal species, the highest proportion holds characteristic species of deciduous forest, where they are associated particularly with beech trees: *Amanita crocea, Craterellus cornucopioides*, *Lactarius vellereus*, *Russula cyanoxantha* and *Russula virescens* (Tab. 1). Also, there were identified some species that occur in both deciduous and coniferous forests which have no specificity only to one of these two habitats. This category includes species of the following genera: *Amanita* (*Amanita pantherina*, *Amanita rubescens* var. *rubescens*), *Boletus* (*Boletus edulis*, *Boletus chrysenteron*), *Russula* (*Russula aurea*, *Russula delica*, *Russula foetens*, *Russula nigricans*, *Russula ochroleuca*, and *Russula vesca*).

The humicolous macromycetes of this association belong to following genera: *Bovista*, *Clitocybe*, *Coprinopsis*, *Coprinus*, *Helvella*, *Laccaria*, *Lycoperdon*, *Macrolepiota*, *Marasmius*, *Mycena*, *Stropharia* and they have a relatively low sharing percentage (18.68%) compared with total number of identified species.

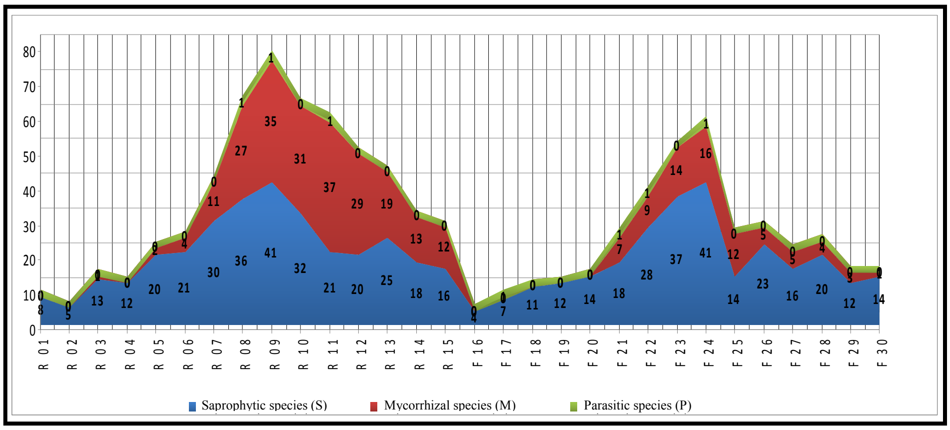

Fig. 4. Ecological spectrum for colected macromycetes of *Hieracio transsilvanico- Piceetum* and *Leucanthemo waldsteinii-Fagetum* associations

After that, we realized comparative analysis between results from those two investigated forest types. Comparative chart of similarity based on Jaccard index values between adjacent sample surfaces were in concordance with cluster analysis and it indicating two different fungal communities: those of *Hieracio transsilvanico-Piceetum* association and those of *Leucanthemo waldsteinii-Fagetum* association (Fig. 5). This index is based on probability that two individuals chosen at random, one from each of those two samples belong to species common to both samples. Estimations for this index take into account its contribution to the real value of this probability actually made on species presence within both sites, but which were not detected in one or both samples [CHAO & al. 2005]. Out of those 243 identified species, 39 species were common to both associations. Analysis of similarity dendrogram indicated that macromycetes species were distributed in two communities, according to Jaccard index values. Limits of species distribution ranges along environmental gradients are an interesting aspect used to identify different communities and determine species assemblages in numbers over many years of study. In the analysis of the similarity dendrogram (Fig. 3**)** it can be observed that, at the first hierarchical level, a separation among phenophases appears, distinguishing, first, macromycetes in vernal season, and, second, the macromycetes in summer and autumnal seasons. Then, in the second hierarchical level, macromycetes within each phenophase are differentiated depending on the forest community. The results suggest that macromycetes species composition is influenced by period of sporocarps occurrence and the environmental factors according to the functional group to which they belong and structure of forest communities. Sample surfaces with high similarity were observed in summer season in July - R06 and R07 (in *Hieracio transsilvanico-Piceetum* association), F21 and F22 (*Leucanthemo waldsteinii-Fagetum* association), in August - R08 and R09 respectively F23 and F24. For autumnal season R14 and R15 respectively F28 and F30 showed a high similarity.

Detrended Correspondence Analysis

Detrended Correspondence Analysis (Fig. 5) shows that, taking into account the macrofungal composition, two groups can be separated within the studied area. The first group located at the left, includes the macromycetes from *Hieracio transsilvanico-Piceetum* association and, the second one includes macromycetes from the *Leucanthemo waldsteinii-Fagetum* at the right.

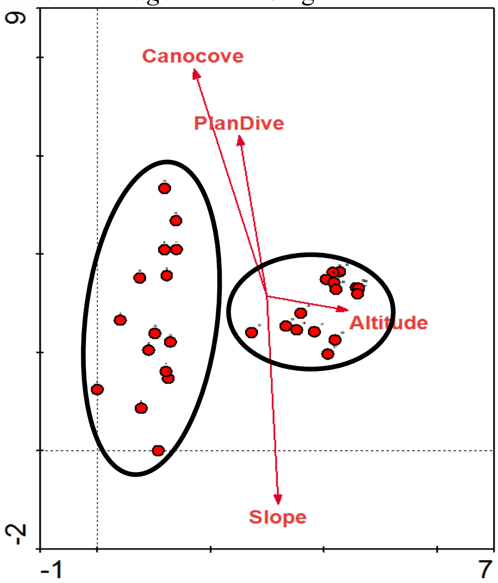

Fig. 5. DCA ordination diagram of the 30 samples using trees canopy covering, plants diversity, slope and altitude as passive variables first two axes presented. Eigenvalues: 1st axis: 0.716, 2nd axis: 0.430, total inertia: 6.974.

The first DCA axis is strongly correlated with altitude (Fig. 5). This suggests that altitude represent the main factor influencing the macromycetes composition in the vegetal communities from Giumalău Massif. This ecological factor generates a differentiation among the vegetal communities from increased altitudes, which are species poorer compared to the communities from lower altitudes including a higher number of (macromycetes) species. The second axis was correlated with plants species diversity, slope and canopy cover, indicating a gradient from relatively open forests stands, on accentuated slopes and richer in plants species to closed forests stands on less inclined terrains and poorer in plants species. Together, the first two axes of DCA explain 16.4% from total variance of macromycetes species and 13.0 of total species-environment relation.

Axes	1	2	3	4	Total inertia
Eigenvalues	0.716	0.430	0.251	0.174	6.974
Lenghts of gradient	4.615	5.334	2.872	3.137	
Species-environment correlations	0.183	0.493	0.236	0.471	
Cumulative percentage variance					
of species data	10.3	16.4	20.0	22.5	
of species-environment relation	2.5	13.0	0	0	
Sum of al eigenvalues					6.974
Sum of all canonical eigenvalues					*1.075*

In conclusion, along the first axis, which explains a higher percentage of variance (10.3%), we can identify an altitudinal gradient, which means that inside of studied area two altitudinal zones for macromycetes distribution have been identified: a) under 1000 m (lower mountain level) where 59% out of total species have been identified; b) upper 1000 m (superior mountain level) where 41% out of total species have been identified. The influence of altitude on macromycetes species composition is consistent with other studies [GOMEZ-HERNANDEZ & WILLIAMS-LINERA, 2011].

The second axis show that trees canopy covering, plants species diversity and slope presents influence also the macromycetes communities composition as it was indicated in other studies [BONET & al. 2004; KÜFFER & SENN-IRLET, 2005; LAGANA & al. 1991]. Obtained results show that canopy cover has an important role in spreading of macrofungi species. Thus, within samples R08, R09 and R10 with 90-95% canopy covering a large number of mycorrhizal fungi has been determined. Moreover, different trophic groups had different responses to the influence of canopy covering. A possible explanation is that canopy is less important for saprophytic fungi than the existence of a given substratum. Our results suggest that canopy cover presents positive influence on mycorrhizal species as long as their number increases in a direct proportion with trees covering degree. Usually, mycorrhizal fungi are located in the upper layers of soil and, often, closely associated with roots of big trees. Regarding to saprophytic macrofungi, their distribution is strongly linked to a certain type of substratum and less dependent on canopy cover [SANTOS-SILVA & al. 2011]. Also, plants species diversity differed between the analyzed communities. But, within the same forest type, trees species composition was comparable for sites located at similar altitudes and, consequently, fungal species composition was relatively similar in all samples made in the same season. Comparing the 2 forests types, macromycetes composition changed, depending on tree species composition of forests and their abundance-dominance.

In conclusion, results of DCA analysis showed us clearly a separation in two different macromycetes groups for investigated areas. Macromycetes species composition is influenced primarily by altitude, and secondarily by plant diversity and canopy covering (Fig. 5). Also, out of the entire number of macromycetes, mycorrhizal macromycetes had a positive correlation with trees canopy covering.

Conclusions

Our results suggest that variation of macromycetes species composition in the two forests types from Giumalău Massif is directly related more to abiotic factors (altitude with influences on the climate) than woody species composition and plants communities diversity. Only complementary, changes in canopy covering, species composition of arboretum, together with some other factors as slope, can influence diversity and abundance of macromycetes.

Macromycetes species composition presents a high degree of similarity between surfaces situated at same altitudes, investigated at the same time (for harvesting of sporocarps). Among all investigated (passive) variables, it seems that altitude is the most important factor influencing the macromycetes species composition in Giumalău Massif. Vegetation diversity (which depends also on altitude) determines changes of macromycetes composition. Slope and canopy cover are less important factors for macromycetes species from vegetal communities in Giumalău Massif. From another perspective, the high diversity of macromycetes from habitats of Giumalau forests enforces us to conserve forests for several reasons. Thus, spruce forests are an important source of mycorrhizal species diversity (*Amanita*, *Boletus*, *Cantharellus*, *Chalciporus*, *Cortinarius*, *Elaphomyces*, *Gomphidius*, *Hydnum*, *Hygrophorus*, *Inocybe*, *Lactarius*, *Leccinum*, *Neolecta*, *Paxillus*, *Porphyrellus*, *Russula*, *Sarcodon*, *Thelephora and Tricholoma*). These fungi are key species in development, balance and preservation of forest communities. The most frequent macromycetes in the spruce forests of Giumalău Massif are common species for coniferous forests, but the most valuable importance is given by some rare species which have been found in few areas: *Elaphomyces granulatus*, *Guepinia helvelloides*, *Helvella acetabulum*, *Hericium alpestre*, *Neolecta vitellina*, *Pterula subulata*, *Rutstroemia bulgarioides*, *Tremella foliacea* and *Tremella encephala*. The presence of large amounts of dead wood and a large diversity in wood species that populate wood substrate clearly favors lignicolous macromycete populations. Conservative importance of habitats in *Leucanthemo waldsteinii-Fagetum* association of Giumalău is emphasized by the presence of few rare species as *Cytidia salicina*, *Hericium coralloides* and *Tremella foliacea*.

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Received: 1 August 2013 / *Accepted*: 10 October 2013

Tab. 1. Macromycetes identified within *Hieracio transsilvanico – Piceetum* and *Leucanthemo waldsteinii – Fagetum* associations

No.	Ecological category	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
1	Sh	*Agaricus sylvaticus* Schaeff.																							1	1						
2	Sh	*Agaricus sylvicola* (Vittad.) Peck																								1	1					
3	Sh	*Albatrellus confluens* (Alb. & Schwein.) Kotl. & Pouzar										1	1	1																		
4	Sh	*Albatrellus ovinus* (Schaeff.) Kotl. & Pouzar									1	1																				
5	Sh	*Aleuria aurantia* (Pers.) Fuckel																							1	1						
6	M	*Amanita battarrae* (Boud.) Bon					1	1		1																						
7	M	*Amanita crocea* (Quél.) Singer																						1								
8	M	*Amanita fulva* Fr.									1	1														1	1					
9	M	*Amanita muscaria* (L.) Lam.								1	1	1	1	1																		
10	M	*Amanita muscaria* var. *aureola* (Kalchbr.) Quél.										1																				
11	M	*Amanita pantherina* (DC.) Krombh.																							1	1	1					
12	M	*Amanita regalis* (Fr.) Michael								1	1	1		1																		
13	M	*Amanita rubescens* var. *rubescens* Pers.						1	1		1		1	1									1	1		1						
14	M	*Amanita excelsa* var. *spissa* (Fr.) Neville & Poumarat								1			1	1	1																	
15	M	*Amanita vaginata* (Bull.) Lam.																								1	1					

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
16	Sl	*Amylostereum areolatum* (Chaillet ex Fr.) Boidin					1	1		1												1										
17	SPl	*Armillaria mellea* (Vahl) P. Kumm.																									1	1	1	1		
18	SPl	*Armillaria ostoyae* (Romagn.) Herink											1	1	1	1	1											1	1	1		
19	Sl	*Ascocoryne sarcoides* (Jacq.) J.W. Groves & D.E. Wilson								1	1			1		1	1						1			1		1				
20	SPl	*Auricularia auricula-judae* (Bull.) Quél.																		1			1	1	1							
21	SPl	*Auricularia mesenterica* (Dicks.) Pers.																			1	1								1		1
22	Scp	*Baeospora myosura* (Fr.) Singer								1	1			1		1	1															
23	Sl	*Bisporella citrina* (Batsch) Korf & S.E. Carp.																						1		1		1				
24	Sl	*Bjerkandera adusta* (Willd.) P. Karst.																					1		1	1		1			1	
25	Sc	*Bolbitius titubans* var. *titubans* (Bull.) Fr.	1		1				1												1											
26	M	*Boletus badius* (Fr.) Fr.							1		1		1			1	1															
27	M	*Boletus calopus* Pers.								1	1	1																				
28	M	*Xerocomellus chrysenteron* (Bull.) Šutara							1		1		1										1	1			1		1			
29	M	*Boletus edulis* Bull.								1	1	1	1		1										1	1		1				
30	M	*Boletus erythropus* var. *erythropus* Pers.								1	1		1	1	1	1	1															
31	M	*Boletus luridus* var. *luridus* Schaeff.									1		1																			
32	M	*Boletus pulverulentus* Opat.											1	1		1	1															
33	M	*Boletus queletii* Schulzer								1		1	1																			
34	M	*Boletus subtomentosus* L.							1			1																				
35	Sh	*Bovista nigrescens* Pers.																							1							
36	Sl	*Bulgaria inquinans* (Pers.) Fr.																							1			1				

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
37	Sl	*Calocera cornea* (Batsch) Fr.					1			1			1																			
38	Sl	*Calocera viscosa* (Pers.) Fr.			1			1	1			1				1	1															
39	M	*Cantharellus cibarius* Fr.								1	1	1		1	1	1	1								1	1	1		1			
40	M	*Craterellus lutescens* (Fr.) Fr.										1	1	1	1																	
41	M	*Craterellus tubaeformis* (Fr.) Quél.							1	1	1	1	1																			
42	M	*Chalciporus piperatus* (Bull.) Bataille							1		1		1	1	1		1															
43	Sl	*Chlorociboria aeruginascens*							1													1		1								
44	Sl	*Chondrostereum purpureum* (Pers.) Pouzar																								1		1	1			
45	M	*Chroogomphus helveticus* (Singer) M.M. Moser										1	1																			
46	Sh	*Clitocybe clavipes* (Pers.) P. Kumm.								1		1			1	1																
47	Sh	*Clitocybe nebularis* (Batsch) P. Kumm.																							1	1		1	1			
48	Sh	*Clitocybe odora* (Bull.) P. Kumm.						1	1		1				1					1					1	1						
49	Sl	*Clitocybula lacerata* (Scop.) Métrod					1		1																							
50	Sc	*Conocybe pubescens* (Gillet) Kühner				1	1																									
51	Sh	*Coprinopsis atramentaria* (Bull.) Redhead																						1								
52	Sh	*Coprinus comatus* (O.F. Müll.) Pers.																							1	1						1
53	M	*Cortinarius caperatus* (Pers.) Fr.								1	1		1	1		1	1															
54	M	*Cortinarius cinnamomeus* (L.) Fr.										1	1																			
55	M	*Cortinarius collinitus* Pers. Fr.										1	1																			
56	M	*Cortinarius croceus* (Schaeff.) Gray									1	1		1																		
57	M	*Cortinarius flexipes* var. *flexipes* Pers. Fr.										1	1																			

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
58	M	*Cortinarius sanguineus* (Wulfen) Fr.								1		1			1		1															
59	M	*Cortinarius semisanguineus* (Fr.) Gillet										1	1			1																
60	M	*Cortinarius trivialis* J.E. Lange																											1			
61	M	*Craterellus cornucopioides* (L.) Pers.																							1	1		1	1			
62	Sl	*Crepidotus applanatus* var. *applanatus* (Pers.) P. Kumm.																						1	1	1						
63	Sl	*Crucibulum laeve* (Huds.) Kambly	1			1	1																1			1				1		1
64	Sl	*Cyathus striatus* (Huds.) Willd.																	1					1				1				
65	Sh	*Cystodermella granulosa* (Batsch) Harmaja						1	1		1				1	1																
66	Sl	*Cytidia salicina* (Fr.) Burt																							1							
67	Sl	*Dacrymyces stillatus* Nees					1			1			1	1																		
68	Sl	*Daldinia concentrica* (Bolton) Ces. & De Not.																				1	1			1				1		
69	P	*Dumontinia tuberosa* (Bull.) L.M. Kohn																	1													
70	M	*Elaphomyces granulatus* Fr.					1		1																							
71	Sh	*Entoloma incanum* (Fr.) Hesler									1	1	1																			
72	Sl	*Exidia glandulosa* (Bull.) Fr.																			1			1	1							1
73	SPl	*Flammulina velutipes* var. *velutipes* (Curtis) Singer																1														
74	SPl	*Fomes fomentarius* (L.) Fr.																1	1	1			1	1		1				1	1	
75	SPl	*Fomitopsis pinicola* (Sw.) P. Karst.	1		1	1	1		1			1		1	1		1					1		1			1					
76	SPl	*Ganoderma applanatum* (Pers.) Pat.			1			1				1					1															
77	Sh	*Geastrum triplex* Jungh.						1		1																						

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
78	Sl	*Gloeophyllum abietinum* (Bull.) P. Karst.						1	1				1	1																		
79	Sl	*Gloeophyllum odoratum* (Wulfen) Imazeki	1	1				1	1			1	1		1		1															
80	Sl	*Gloeophyllum sepiarium* (Wulfen) P. Karst.	1		1			1	1			1			1																	
81	M	*Gomphidius glutinosus* (Schaeff.) Fr.									1		1		1																	
82	Sh	*Guepinia helvelloides* (DC.) Fr.								1		1																				
83	Sl	*Gymnopilus penetrans* (Fr.) Murrill						1	1			1	1	1																		
84	Sh	*Gymnopus dryophilus* (Bull.) Murrill						1	1																							
85	Sf	*Gymnopus perforans* (Hoffm.) Antonín & Noordel.						1	1		1																					
86	Sf	*Gymnopus peronatus* (Bolton) Gray																							1							
87	Sh	*Gyromitra gigas* (Krombh.) Cooke																		1												
88	Sh	*Gyromitra infula* (Schaeff.) Quél.			1	1																										
89	Sh	*Helvella acetabulum* (L.) Quél.			1															1												
90	Sh	*Helvella crispa* (Scop.) Fr.																	1	1	1											
91	Sh	*Helvella elastica* Bull.																	1	1												
92	SPl	*Hericium alpestre* Pers.									1				1																	
93	SPl	*Hericium coralloides* (Scop.) Pers.																							1			1				
94	SPl	*Heterobasidion annosum* (Fr.) Bref.	1	1						1		1		1																		
95	Sh	*Hydnellum ferrugineum* (Fr.) P. Karst.										1	1																			
96	Sl	*Hydnellum geogenium* (Fr.) Banker								1	1																					
97	Sh	*Hydnellum suaveolens* (Scop.) P. Karst.								1	1																					
98	M	*Hydnum repandum* L.								1	1				1	1									1	1					1	

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
99	Sl	*Hygrophoropsis aurantiaca* (Wulfen) Maire												1	1																	
100	M	*Hygrophorus agathosmus* (Fr.) Fr.									1		1	1		1	1															
101	M	*Hygrophorus chrysodon* (Batsch) Fr.																									1	1				
102	M	*Hygrophorus cossus* (Sowerby) Fr.																									1					
103	M	*Hygrophorus discoxanthus* (Fr.) Rea												1	1																	
104	M	*Hygrophorus olivaceoalbus* (Fr.) Fr.							1			1	1		1	1																
105	M	*Hygrophorus persicolor* Ricek							1			1																				
106	Sl	*Hypholoma capnoides* (Fr.) P. Kumm.								1	1		1	1																		
107	Sl	*Hypholoma fasciculare* (Huds.) P. Kumm.						1	1														1	1		1		1			1	
108	Sl	*Hypholoma lateritium* (Schaeff.) P. Kumm.																						1		1	1		1			
109	Sl	*Hypoxylon fragiforme* (Pers.) J. Kickx f.																			1	1			1	1				1		1
110	Sh	*Infundibulicybe geotropa* (Bull.) Harmaja																											1			
111	M	*Inocybe assimilata* Britzelm																								1	1					
112	M	*Inocybe geophylla* var. *geophylla* (Fr.) P. Kumm.								1	1				1										1			1				
113	M	*Inocybe geophylla* var. *lilacina* Gillet																							1	1						
114	M	*Inocybe rimosa* (Bull.) P. Kumm.																								1						
115	Sl	*Kretzschmaria deusta* (Hoffm.) P.M.D. Martin								1	1				1					1		1		1						1		1
116	Sh	*Laccaria amethystina* Cooke								1	1														1	1			1			
117	Sh	*Laccaria bicolor* (Maire) P.D. Orton									1	1																				
118	Sh	*Laccaria laccata* (Scop.) Cooke				1	1		1			1	1	1		1	1						1	1		1					1	1
119	Sh	*Laccaria proxima* (Boud.) Pat.								1	1	1													1	1						

No.	Ecological category	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
120	Sh	*Laccaria tortilis* (Bolton) Cooke						1	1	1																						
121	M	*Lactarius deterrimus* Gröger								1	1	1	1	1																		
122	M	*Lactarius lignyotus* var. *lignyotus* Fr.										1	1																			
123	M	*Lactarius picinus* Fr.										1		1																		
124	M	*Lactarius rufus* (Scop.) Fr.								1	1																					
125	M	*Lactarius salmonicolor* R. Heim & Leclair									1		1	1																		
126	M	*Lactarius scrobiculatus*(Scop.) Fr.											1	1		1																
127	M	*Lactarius trivialis* (Fr.) Fr.								1	1																					
128	M	*Lactarius vellereus* var. *vellereus* (Fr.) Fr.																							1	1						
129	M	*Lactarius volemus* (Fr.) Fr.									1														1		1		1			
130	M	*Leccinum piceinum* Pilát & Dermek.									1																					
131	M	*Leccinum scabrum* (Bull.) Gray																					1	1	1		1					
132	Sh	*Lepiota castanea* Quél.								1	1																					
133	Sh	*Lepiota clypeolaria* (Bull.) P. Kumm.										1																1				
134	Sh	*Lepista flaccida* (Sowerby) Pat.				1	1		1			1		1																		
135	Sh	*Lepista nuda* (Bull.) Cooke								1	1				1	1																
136	M	*Leucocortinarius bulbiger* (Alb. & Schwein.) Singer												1																		
137	Sh	*Lichenomphalia umbellifera* (L.) Redhead, Lutzoni, Moncalvo & Vilgalys						1	1																							
138	Sh	*Lycoperdon echinatum* Pers.																								1	1					
139	Sh	*Lycoperdon perlatum* Pers.									1														1				1			
140	Sl	*Lycoperdon pyriforme* Schaeff.																							1	1			1			

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
141	Sh	*Lycoperdon umbrinum* Pers.								1	1		1	1																		
142	Sh	*Lyophyllum connatum* (Schumach.) Singer								1	1				1	1	1															
143	Sh	*Lyophyllum decastes* (Fr.) Singer										1		1																		
144	Sh	*Macrolepiota procera* var. *procera* (Scop.) Singer									1	1	1		1	1									1	1		1				
145	Sh	*Macrolepiota rachodes* var. *bohemica* (Wichanský) Bellù & Lanzoni								1		1																				
146	Sh	*Marasmius alliaceus* (Jacq.) Fr.						1	1		1														1	1					1	1
147	Sf	*Marasmius androsaceus* (L.) Fr.						1	1		1																					
148	P	*Marasmius oreades* (Bolton) Fr.																					1	1		1						
149	Sl	*Marasmius rotula* (Scop.) Fr.																				1	1	1								
150	Sl	*Megacollybia platyphylla* (Pers.) Kotl. & Pouzar																					1	1								
151	Sl	*Merulius tremellosus* Schrad.								1		1			1										1				1			
152	Sl	*Gymnopus foetidus* (Sowerby) J. L. Mata & R. H. Petersen						1	1																							
153	Sh	*Mycena aetites* (Fr.) Quél.								1																						
154	Sh	*Mycena aurantiomarginata* (Fr.) Quél.							1			1																				
155	Sh	*Mycena crocata* (Schrad.) P. Kumm.																						1				1				
156	Sl	*Mycena epipterygia* (Scop.) Gray							1		1				1	1	1															
157	Sh	*Mycena galopus* var. *candida* J. E. Lange			1		1	1																								
158	Sl	*Mycena haematopus* (Pers.) P. Kumm.																							1		1		1		1	1
159	Sh	*Mycena pelianthina* (Fr.) Quél.																							1	1				1	1	
160	Sh	*Mycena pura* (Pers.) P. Kumm.								1	1		1	1	1	1							1	1			1	1		1		

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
161	Sh	*Mycena rosella* (Fr.) P. Kumm.								1		1	1		1	1	1							1	1							
162	Sl	*Mycena silvae nigrae* Maas Geest. & Schwöbel								1						1																
163	SPl	*Nectria cinnabarina* (Tode) Fr.																							1					1		
164	M	*Neolecta vitellina* (Bres.) Korf & J. K. Rogers			1																											
165	Sh	*Omphalina demissa* (Fr.) Quél.					1																									
166	Sl	*Oudemansiella mucida* (Schrad.) Höhn.																							1			1	1			
167	Sc	*Panaeolus semiovatus* var. *semiovatus* (Sowerby) S. Lundell & Nannf.					1		1						1		1															
168	Sl	*Panellus stipticus* (Bull.) P. Karst.																							1	1					1	
169	M	*Paxillus involutus* (Batsch) Fr.								1	1		1	1																		
170	Sh	*Peziza badiofusca* (Boud.) Dennis							1		1																					
171	Sl	*Phlebia radiata* Fr.																				1		1		1						
172	SPl	*Pholiota adiposa* (Batsch) P. Kumm.										1			1																	
173	Sl	*Pholiota astragalina* (Fr.) Singer											1	1																		
174	SPl	*Pholiota squarrosa* (Vahl) P. Kumm.																							1		1	1	1			
175	SPl	*Piptoporus betulinus* (Bull.) P. Karst.				1	1			1		1	1										1	1		1				1		1
176	Pl	*Pleurotus dryinus* (Pers.) P. Kumm.								1	1		1																			
177	SPl	*Pleurotus ostreatus* (Jacq.) P. Kumm.																							1			1				1
178	Sl	*Plicaturopsis crispa* (Pers.) D. A. Reid																								1	1					
179	Sl	*Pluteus cervinus* (Schaeff.) P. Kumm.																				1			1	1						
180	Sl	*Pluteus salicinus* (Pers.) P. Kumm.																									1	1				
181	Sl	*Pluteus thomsonii* (Berk. & Broome) Dennis																								1						

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
182	Sl	*Polyporus brumalis* (Pers.) Fr.																							1	1						
183	Sl	*Polyporus varius* (Pers.) Fr.																								1		1	1			
184	M	*Tylopilus porphyrosporus* (Fr. & Hök) A. H. Sm. & Thiers								1	1		1		1		1															
185	Sl	*Pseudoclitocybe cyathiformis* (Bull.) Singer																								1	1		1			1
186	Sl	*Pseudohydnum gelatinosum* (Scop.) P. Karst.								1	1		1	1	1		1															
187	Sh	*Pterula subulata* Fr.										1																				
188	Sl	*Pycnoporus cinnabarinus* (Jacq.) P. Karst.																			1	1			1		1	1				
189	Sh	*Ramaria botrytis* (Pers.) Ricken								1	1															1	1					
190	Sh	*Ramaria flava* (Schaeff.) Quél.								1	1														1		1					
191	Sh	*Ramaria pallida* (Schaeff.) Ricken								1	1																					
192	Sh	*Rhodocollybia butyracea* (Bull.) Lennox							1		1																					
193	Sh	*Rhodocollybia maculata* (Alb. & Schwein.) Singer									1	1				1	1															
194	M	*Russula aeruginosa* Massee								1	1		1																			
195	M	*Russula aurea* Pers.																							1					1		1
196	M	*Russula badia* Quél.								1	1																					
197	M	*Russula cyanoxantha* (Schaeff.) Fr.																					1	1		1				1	1	
198	M	*Russula delica* Fr.										1			1	1	1								1		1					
199	M	*Russula foetens* Pers.						1	1				1	1		1							1	1				1				
200	M	*Russula fragilis* var. *fragilis* Fr.								1	1	1	1	1																		
201	M	*Russula heterophylla* (Fr.) Fr.										1	1																			

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
202	M	*Russula integra* var. *integra* (L.) Fr.										1	1	1																		
203	M	*Russula nigricans* Fr.								1	1	1	1	1		1	1							1		1					1	
204	M	*Russula ochroleuca* Fr.										1		1	1										1	1						
205	M	*Russula queletii* Fr.										1		1																		
206	M	*Russula vesca* Fr.																					1	1						1		
207	M	*Russula virescens* (Schaeff.) Fr.																					1	1	1							
208	Scp	*Rutstroemia bulgarioides* P. Karst.	1	1	1																											
209	M	*Sarcodon imbricatus* (L.) P. Karst.								1		1	1	1																		
210	Sl	*Sarcoscypha coccinea* (Gray) Boud.																	1	1												
211	SPl	*Schizophyllum commune* Fr.																			1	1	1	1	1					1		1
212	Sl	*Scutellinia scutellata* (L.) Lambotte						1	1			1		1																		
213	Sl	*Sparassis crispa* (Wulfen) Fr.								1		1																				
214	SPl	*Climacocystis borealis* (Fr.) Kotl. & Pouzar									1				1	1																
215	SPl	*Stereum gausapatum* (Fr.) Fr.				1	1					1																				
216	SPl	*Stereum hirsutum* (Willd.) Pers.				1	1			1					1		1	1	1	1			1	1		1				1	1	
217	Scp	*Strobilurus esculentus* (Wulfen) Singer	1		1		1																									
218	Sh	*Stropharia aeruginosa* (Curtis) Quél.																					1	1		1		1				
219	Sh	*Stropharia coronilla* (Bull. ex DC.) Quél.																						1								
220	Sl	*Tapinella atrotomentosa* (Batsch) Šutara								1	1																					
221	M	*Thelephora palmata* (Scop.) Fr.													1																	

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
222	M	*Thelephora terrestris* Ehrh.						1	1		1				1																	
223	Sl	*Trametes hirsuta* (Wulfen) Lloyd				1	1	1											1		1		1		1					1	1	
224	SPl	*Trametes pubescens* (Schumach.) Pilát																			1			1	1					1		1
225	Sl	*Trametes versicolor* (L.) Lloyd																			1			1		1						
226	Sl	*Tremella encephala* Willd.							1		1			1																		
227	Sl	*Tremella foliacea* Pers.									1		1													1		1				
228	Sl	*Tremella mesenterica* Retz.																											1	1		
229	Sl	*Trichaptum abietinum* (Dicks.) Ryvarden				1	1		1	1	1		1		1	1																
230	M	*Tricholoma terreum* (Schaeff.) P. Kumm.											1	1																		
231	M	*Tricholoma saponaceum* Fr. P. Kumm.												1	1															1		
232	M	*Tricholoma batschii* Gulden								1																						
233	M	*Tricholoma sulphureum* var. *sulphureum* (Bull.) P. Kumm.									1															1	1					
234	M	*Tricholoma vaccinum* (Schaeff.) P. Kumm.								1	1		1	1	1		1															
235	Sl	*Tricholomopsis decora* (Fr.) Singer							1		1				1	1																
236	Sl	*Tricholomopsis rutilans* (Schaeff.) Singer								1	1	1	1		1		1															
237	Sl	*Tubaria furfuracea* (Pers.) Gillet			1																											
238	M	*Tylopilus felleus* (Bull.) P. Karst.								1	1																					
239	Sl	*Xeromphalina campanella* (Batsch) Maire		1	1		1				1																					

No.	Ecolo-gical cate-gory	Species	R 01	R 02	R 03	R 04	R 05	R 06	R 07	R 08	R 09	R 10	R 11	R 12	R 13	R 14	R 15	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23	F 24	F 25	F 26	F 27	F 28	F 29	F 30
240	Sl	*Xerula radicata* (Relhan) Dörfelt																			1	1	1			1				1	1	
241	Sl	*Xylaria hypoxylon* (L.) Grev.																			1			1		1						
242	Sl	*Xylaria longipes* Nitschke																				1	1							1		
243	Sl	*Xylaria polymorpha* (Pers.) Grev.		1	1	1	1				1							1		1				1						1	1	
TOTAL			**8**	**5**	**14**	**12**	**22**	**25**	**41**	**64**	**77**	**63**	**59**	**49**	**44**	**31**	**28**	**4**	**8**	**11**	**12**	**14**	**26**	**38**	**51**	**58**	**26**	**28**	**21**	**24**	**15**	**15**
Mychorrizal species			**84**																													
Saprophyte species on cones			**3**																													
Coprophilous saprophyte species			**3**																													
Foliicolous saprophyte species			**3**																													
Humicolous saprophyte species			**59**																													
Lignicolous saprophyte species			**67**																													
Lignicolous saproparasite species			**21**																													
Lignicolous parasite species			**1**																													
Parasite species			**2**																													

LEGEND:

- macromycetes identified in *Hieracio transsilvanico – Piceetum* association
- macromycetes identified in *Leucanthemo waldsteinii – Fagetum* association
- macromycetes identified in both associations

May, June, July, August, September, October