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Comparison of macrofungi communities and examination of macrofungi–plant interactions in forest stands in North Hungary

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Summary: Parallel phyto- and mycocoenological investigations have been made since 2001 in all characteristic forest types in Börzsöny Mts., North Hungary. The main aim of this work was the examination of similarities between plant and fungal communities, as well as the plant–fungi connections within certain habitats. Among the total 381 macrofungi species documented, 330 occurred in the investigated 7 forest stands. Wood-inhabiting fungal communities of coniferous stands can be separated unambiguously from those of deciduous stands. Communities of deciduous stands can be divided into two subgroups: those fructifying in wet and in semidry stands. The main factors which influence the composition of wood inhabiting fungal communities seem to be, in decreasing order: (1) crown layer composition; and (2) soil properties (probably only humidity). Wood-inhabiting fungal communities do not show any relation with the underwood layer of particular plant associations. Amongst soil inhabiting fungal communities, three groups can be separated: (1) those of coniferous stands and alderwood; (2) those of the two climax stands; and (3) those of the two edaphic deciduous stands. Classification of these communities is similar to classification of plants of underwood layers. Probably both are dependent upon soil properties (humidity and pH) of particular habitats, but the range of mycorrhizal partners is also decisive for macrofungi communities. All investigated stands are under forestry management, with low quantity of dead and infected wood, so forestry management type may have a great influence in composition of both wood and soil saprotrophic fungal communities.

Key words: plant and macrofungi communities, classification, similarities

Introduction

Börzsöny Mts., situated in North Hungary is a medium explored territory from the mycological point of view. Occurrence data of 153 species is documented in the Fungi Collection of the Hungarian Natural Museum (*Babos,* 1989), 200 data of 160 species – among them 136 new – was published by *Rimóczi* (1994). *Albert* (1980) published the occurrence of *Leccinum holopus* (Rostk.) Watl.; during the XII. Cortinarius Congress another 260 species were collected in the area (*Anonymous*, 1995).

The aim of the study was to examine similarities between plant and fungal communities, as well as the plant-fungus communities within the particular habitats.

Material and method

Parallel phyto- and mycocoenological investigations have been made since 2001 in all characteristic forest types in Börzsöny Mts. All macrofungi species collected were documented with fungaria, date and place of occurrence, as well as with determination of substrate. Literatures used for identification were publications of *Moser* (1993), *Jülich* (1993) *Jülich* (1989) and *Hansen & Knudsen* (1992, 1997). Determination and characterisation of plant communities and species list have been made in 2001–2002 with Braun-Blanquet method.

For classification of plant- and fungal communities, the NuCoSA software was used *Tóthmérész,* 1996). Plant communities were classified with index of Jaccard, Complete Linkage, the crown-layer and the underwood layers separately. Fungal communities were classified using the index of Baroni-Urbani (to compensate the differences between sample sizes and to make it compatible with the classification of plant communities), Complete Linkage, to separate the wood inhabiting (wood saprotrophic and parasitic) and soil inhabiting (soil saprotrophic and mycorrhizal) communities.

Characterisation of investigated stands (nomenclature after *Borhidi & Sánta,* 1999):

1. **Hornbeam–oak forest** (*Carici pilosae–Carpinetum*): situated in Deszkametsző-valley, at 260–320 m altitude above sea-level, developed on brown forest soil, age 74, 78 and 88 years. The dominant tree was the hornbeam, but beech, sessile oak and Turkey oak also occurred. Shrub layer

was missing; dominant species in herb layer were *Carex pilosa* and *Galium odoratum*.

2. **Alluvial alder forest** (*Aegopodio–Alnetum*): situated in Morgó-creek-valley, at 240 m altitude above sea level, developed on alluvial soil, age: 63 years. Dominant tree was the alder, with occurrence of white and brittle willows. Shrub layer is characterised by *Corylus avellana, Acer campestre, A. platanoides, Cornus sanguinea, C. mas* and *Sambucus nigra*. The dominant plant in the herb layer was *Aegopodium podagraria*.

3. **Scotch pine plantation** (*Pinetum cultum*): situated in Nagy-Vasfazék-valley, at 300 m altitude above sea-level, planted on podzolic brown forest soil in place of pastureland, age: 53 years. Characteristic trees beside Scotch pine were *Pinus nigra* and *Larix decidua*. Shrub layer can be characterised by *Acer campestre, Ligustrum vulgare* and *Crataegus monogyna*. The herb layer was poor, mainly with nitrophile species.

4. **Oak forest** (*Quercetum petraeae–cerris*): situated in Taxi-nyiladék, at 320 m altitude above sea-level, developed on brown forest soil, age: 53 years. The dominant trees were sessile and Turkey oak. Shrub-layer can be characterised by *Ligustrum vulgare, Crataegus monogyna* and *Rosa canina*. The dominant herbs were *Poa angustifolia, Poa nemoralis* and *Festuca heterophylla*.

5. **Spruce plantation** (*Piceetum cultum*): situated in Bajdázó, at 290 m altitude above sea-level, planted on brown forest soil, age 48 years. In addition to the dominant spruce, *Pinus sylvestris* and *Larix decidua* also occurred. The shrub-layer was poor, consisting exclusively of *Sambucus nigra*. The poor herb-layer can be characterised by *Oxalis acetosella, Polygonatum latifolium, Dryopteris filix-mas*.

6. **Calcifuge beech forest** (*Luzulo–Fagetum*): situated in Cseresnyés-valley, at 400–480 m altitude above sea-level, developed on ranker soil, age 102 years. The crown-layer composed of beech, the shrub-layer was missing, and the characteristic the herbs were besides the dominant *Luzula luzuloides: Dicranum scoparium* and *Polytrichum* sp.

7. **Calcifuge oak forest** (*Deschampsio–Quercetum*): situated in Cseresnyés-valley, at 400–480 m altitude above sea-level, developed on ranker soil. Characteristic trees were oaks with a few beech trees, the shrub-layer was missing, the herb-layer was dominated by *Luzula luzuloides*.

8. **Hornbeam–oak forest reserve** (*Carici pilosae–Carpinetum*): situated at Pogány-rózsás, this forest reserve have not been included in classifications, its macrofungi data was used only for comparison of managed and unmanaged stands. In this reserve, no forestry management was done.

All forest stands are under forestry management except No. 8, the forest reserve.

Results and discussion

Among the total 381 macrofungi species documented, 330 occurred in the investigated 7 forest stands.

Wood inhabiting fungal communities of coniferous stands (*Pinetum* and *Piceetum*) differs unambiguously from those of deciduous stands (*Figure 1*). In the second group two subgroups can be separated: those developed on wet soils (alder forest and hornbeam–oak forest) and those on semidry soils (calcifuge stands and oak forest). Wood saprotrophic species have a decisive role in wood inhabiting communities grouping. Forestry management can cause the occurrence of only a few necrotrophic parasites. That is why necrotrophic parasites do not have considerable influence on the composition of these communities.

There is no relationship between the wood inhabiting fungal communities and the underwood-layer plants of particular stands (*Figure 2*). As a conclusion, it can be stated that the main factors which influence the composition of wood inhabiting fungal communities are in decreasing order: (1) crown layer composition which separates the communities of deciduous, respectively coniferous stands; (2) soil properties (probably only humidity) which separates the communities developed on wet and semidry soils.

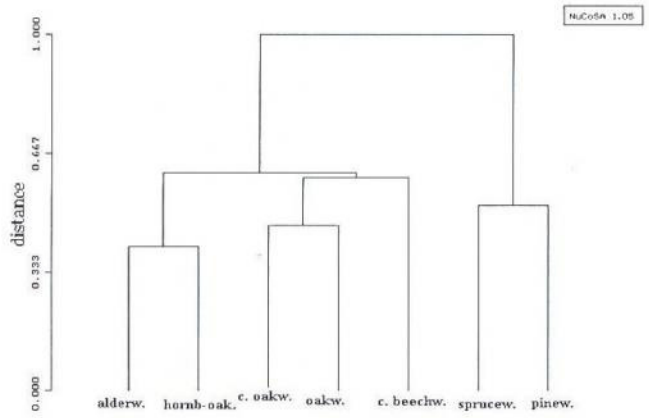

Figure 1 Classification of wood inhabiting fungal communities of different stands using the index of Baroni-Urbani, Complete Linkage. Alderw.= alder forest; hornb-oak.= hornbeam-oak forest; c. oakw.= calcifuge oak forest; c. beechw.= calcifuge beech forest; oakw.= oak forest; sprucew.= spruce forest; pinew.= pine forest

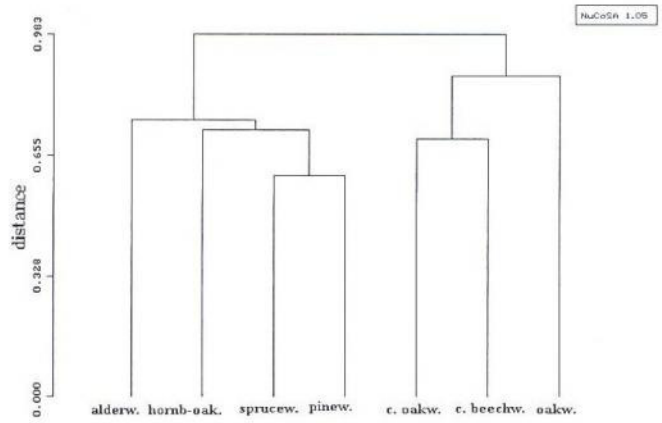

Figure 2 Classification of underwood layer plants using the index of Jaccard, Complete Linkage. Alderw.= alder forest; hornb-oak.= hornbeam-oak forest; c. oakw.= calcifuge oak forest; c. beechw.= calcifuge beech forest; oakw.= oak forest; sprucew.= spruce forest; pinew.= pine forest.

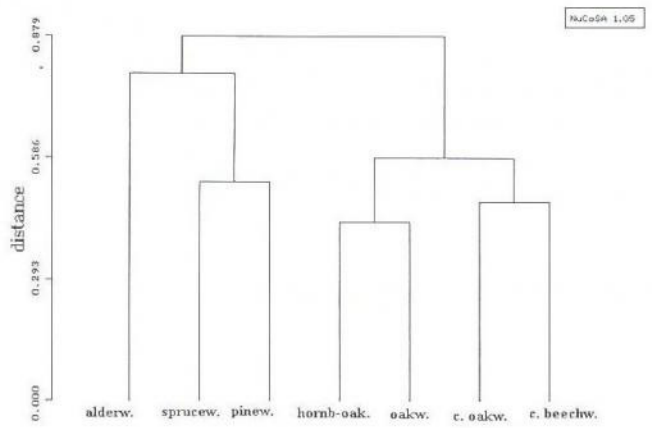

Figure 3 Classification of soil inhabiting fungal communities of different stands using the index of Baroni-Urbani, Complete Linkage. Alderw.= alder forest; hornb-oak.= hornbeam-oak forest; c. oakw.= calcifuge oak forest; c. beechw.= calcifuge beech forest; oakw.= oak forest; sprucew.= spruce forest; pinew.= pine forest

Soil inhabiting fungal communities can be separated in two groups (*Figure 3*). In the first group a strong similarity exists between *Pinetum* and *Piceetum*, but alder forest stand belongs also to this group. The second group has two subgroups: hornbeam-oak forest and oak forest; and calcifuge beech forest and calcifuge oak forest.This classification is caused by both mycorrhizal and soil saprotrophic species, these two functions have a significant role in the composition of specific communities. Classification of these communities shows a strong connection with the classification of plant underwood layers of particular stands. It is possible that both are dependent upon the soil properties – humidity and pH – of particular habitats. It seems that the range of mycorrhizal partners also have a significant role in the composition of these communities, especially in the case of coniferous stands. So, the main factors, which influence the composition of soil inhabiting fungal communities – with equal importance – are: (1) soil properties (probably humidity and pH) which separate in the first step the communities of deciduous stands from coniferous (and alder forest); in the second step, the climax stands from the calcifuge stands with acidic soil;

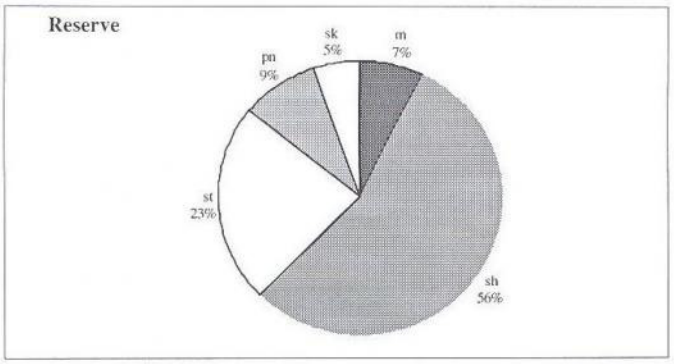

Figure 4 Functional spectra of the cose area of the forest reserve without forestry influence in Börzsöny. Dark = wood inhabiting groups: sh – wood saprotrophic; pn – necroteophic parasite. Light = soil inhabiting groups: St – soil saprotrophic; sk – saprotrophs on plant remains; m – mycorrhizal

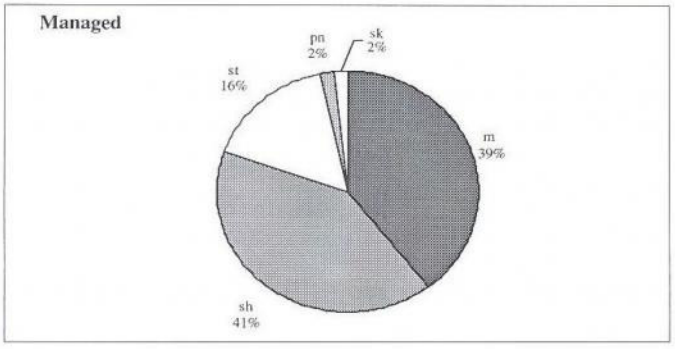

Figure 5. Functional spectra of the investigated hornbeam-oak forest stand. Dark = wood inhabiting groups: sh – wood saprotrophic; pn – necroteophic parasite. Light = soil inhabiting groups: St – soil saprotrophic; sk – saprotrophs on plant remains; m – mycorrhizal.

(2) mycorrhizal partner composition which separates the communities of deciduous stands from those of the coniferous (and alder forest) stand.

Forestry management is probably also important in the composition of these communities. It may have a great influence mainly on the occurrence of necrotrophic parasites, these species occurring in low number in managed stands. Comparing functional spectra of the investigated hornbeam–oak forest with the cose area of the forest reserve in Börzsöny without forestry influence (not included in classifications), it is evident that soil inhabiting fungal communities have a subordinate role in forest reserves, while they have a significant and decisive role in investigated stands of present work (*Figures 4 and 5*).

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