

Diversity and ecology of selected lignicolous Ascomycetes in the Bohemian Switzerland National Park (Czech Republic)

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Lignicolous pyrenomycetes, their anamorphs and asexually reproducing Ascomycetes were investigated on deciduous and coniferous wood at 10 localities of the Bohemian Switzerland National Park (České Švýcarsko in Czech) during 2003–2005. A total number of 109 species was recorded, 11 species were found both as teleomorph and anamorph. Individual localities were evaluated from the viewpoint of Ascomycetes diversity. Ecological demands, relationship with the type of substratum, and microhabitat preferences were noted and several ecological groups are suggested. Rare and endangered species and factors affecting Ascomycetes diversity are discussed. Several species new to the Czech Republic were recorded, viz. *Apiorhynchostoma altipetum*, *Camarops pugillus*, *Crassochaeta fusispora*, *Lophiotrema boreale*, and *Togniniella acerosa*.

Key words: ascomycetes, lignicolous pyrenomycetes, biodiversity, ecology, endangered species.

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Lignikolní pyrenomycety, jejich anamorfy a nepohlavně se rozmnožující askomycety byly zkoumány během let 2003–2005 na listnatých i jehličnatých dřevinách na 10 lokalitách v Národním parku České Švýcarsko. Celkem bylo zaznamenáno 109 druhů, 11 druhů bylo nalezeno ve stadiu teleomorfy i anamorfy. Jednotlivé lokality jsou zhodnoceny z hlediska biodiverzity askomycetů. Během práce byly zaznamenány ekologické nároky, vztah k substrátu a mikrostanovištní preference jednotlivých druhů, na jejichž základě je diskutováno několik ekologických skupin. Jsou zmíněny vzácné a ohrožené druhy a diskutovány faktory ovlivňující jejich výskyt. Mezi nalezenými druhy se vyskytlo několik nových pro Českou republiku: *Apiorhynchostoma altipetum*, *Camarops pugillus*, *Crassochaeta fusispora*, *Lophiotrema boreale*, *Togniniella acerosa*.

INTRODUCTION

The Bohemian Switzerland National Park (Czech Republic, northern Bohemia, see Fig. 1) represents a typical erosive countryside that was formed by erosion of a few hundred metres of sea sediments. Unique features of the area are deeply eroded sandstone cliffs and narrow gorges that provide a microclimate suitable for the occurrence of many alpine and sub-alpine species at a low altitude. The

sandstone sediments are penetrated by cenozoic eruptive rocks in many places. All these factors provide suitable conditions for remarkable species and ecosystems richness.

The natural conditions of the Bohemian Switzerland National Park (České Švýcarsko in Czech) are especially favourable for the occurrence of lignicolous species due to preserved natural and particularly relict forests with a high quantity of decaying wood. In the area studied, the accumulated mass of wood is distributed across a heterogeneous space in which various abiotic and biotic factors ensure a high level of habitat diversity. Based on my current experience and extensive collecting of Ascomycetes in this area, the largest group of fungi with an enormous morphological and ecological variety, I would like to present an overview of the collected species. The list includes pyrenomycetes (perithecial and ascostromatic Ascomycetes), their anamorphs and other asexually reproducing fungi. Furthermore I would like to address their ecology and evaluate the significance of the studied localities with respect to their diversity.

MATERIAL AND METHODS

Literature survey and the present state of knowledge. According to Svrček (1965), mycological research in the Labské pískovce region (including the National Park) was quite rare in the past years. It focused mainly on selected groups of fungi (especially on macromycetes and parasitic micromycetes). Saprophytic micromycetes (including lignicolous pyrenomycetes) were studied by Svrček, Urban (Urban 1958), Podlahová (Podlahová 1974, Hilber and Hilber 1983), Pouzar, Prášil and Suková. Most of their finds have never been published and only a few samples were deposited in the main Czech mycological herbaria (PRC, PRM). A new species of *Lasiosphaeria* (*L. meznaenzis* Podlahová) was described from the type locality near the village of Mezná (Hilber and Hilber 1983). These facts demonstrate an absence of more extensive Ascomycetes research at the studied localities.

Since the foundation of the National Park in 2000, intensive systematic mycological research has been carried out focused on macromycetes and micromycetes (e.g. Holec and Suková 2003, Holec 2007, Tůmová 2006).

Field work. Collecting activities were carried out irregularly in spring, summer and autumn during the years 2003–2005. Particular attention was paid to large trunks in advanced stages of decomposition with soft and damp wood. Other kinds of dead wood, including stumps of fallen trees, twigs, branches, rotten pieces of wood lying in the litter and peeled off bark, were examined as well. Material collected at the localities was dried and examined in the laboratory under the microscope and identified. Specimens of the species listed in Tab. 1 are deposited in the PRC herbarium (Charles University) in Prague.

Areas studied. Lignicolous pyrenomycetes and anamorphic Ascomycetes were studied at 10 localities during 2003–2005. The localities were chosen according to the occurrence of natural forest communities and presence of an appropriate quantity of wood in different stages of decay. Localities with ravine forests, herb-rich beech forests, acidophilous beech forests, relict pine forests and short segments in the canyons of the Kamenice and Křinice rivers were also included. However, not all sites were studied with the same intensity; the most frequently and regularly visited localities included Růžák, Suchá Bělá, Ponova louka and the Kamenice River canyon. A brief specification of localities is added (fide Kuncová et al. 1999, Härtel 1999), including the type of forest community (Chytrý et al. 2001, Härtel 1999).



Fig.1. Geographic position of the Bohemian Switzerland National Park.

Babylon

1st zone of the National Park situated 3 km NE of Vysoká Lípa, 18.6 ha.

Alt.: 300–350 m a.s.l.

Coordinates of the centre: 50°52'14.377"N, 14°22'54.642"E.

Dominating tree species: *Pinus sylvestris*.

Forest community: *Dicrano-Pinetum*, *Ledum palustre-Pinus sylvestris*.

Borový důl

Narrow pass among sandstone blocks, W-E orientation, situated c. 1 km W of Ponova louka 1st zone.

Alt.: 360–380 m a.s.l.

Coordinates of the centre: 50°53'3.619"N, 14°18'45.88"E.

Dominating tree species: *Fagus sylvatica*.

Forest community: *Luzulo-Fagetum*.

Český vrch

Volcanic hill situated at the western margin of the village of Chřibská.

Alt.: 400–425 m a.s.l.

Coordinates of the centre: 50°51'54.443"N, 14°26'48.589"E.

Dominating tree species: *Fagus sylvatica*.

Forest community: *Melico-Fagetum*.

Kamenice River canyon

The research in this canyon included three segments along the Kamenice River; part of the Divoká soutěska gorge (about 0.5 km long segments in both directions from Mezní můstek and a 1 km long segment of the deep gorge between Soorgrund and the Kamenice River) and Srbskokamenská soutěska gorge (a long segment of about 2.5 km between Ptačí kámen rock and Dolský mlýn mill).

Alt.: 200–270 m a.s.l.

Coordinates of the margins of studied segments:

First segment: 50°52'12.427"N, 14°17'12.699"E; 50°51'51.522"N, 14°18'7.653"E.

Second segment: 50°51'56.175"N, 14°19'34.346"E; 50°51'50.093"N, 14°19'12.744"E.

Third segment: 50°51'27.67"N, 14°19'54.193"E; 50°50'57.684"N, 14°20'50.057"E.

Dominating tree species: *Picea abies*.

Rarely occurring wood species: *Alnus glutinosa*, *Fagus sylvatica*.

Koliště

Locality situated on top of a volcanic hill, c. 2 km NW of the village of Jetřichovice.

Alt.: 410–440 m a.s.l.

Coordinates of the centre: 50°51'58.118"N, 14°23'5.498"E.

Dominating tree species: *Fagus sylvatica*.

Forest community: *Melico-Fagetum*.

Kyjovské valley

Narrow valley of the Křinice River mostly E-W oriented, about 5 kilometres long, beginning in the village of Kyjov and continuing NW to the state frontier. The fungi were studied in the section from Kyjov to "Zlé díry".

Alt.: 380–400 m a.s.l.

Coordinates of the margins of studied segment: 50°54'46.861"N, 14°27'28.742"E; 50°54'52.943"N, 14°26'32.954"E.

Dominating tree species: *Picea abies*.

Rarely occurring tree species (only along the river): *Acer pseudoplatanus*, *Alnus glutinosa*.

Mlýny

Volcanic elevation 3 km NE of Vysoká Lípa. The locality is situated on the NE hillside with volcanic sub-soil.

Alt.: 380 m a.s.l.

Coordinates of the centre: 50°52'39.996"N, 14°22'2.314"E.

Dominating wood species: *Fraxinus excelsior*, *Fagus sylvatica*.

Forest community: *Melico-Fagetum*, *Mercuriali-Fraxinetum*.

Ponova louka

Part of the 1st zone of the National Park situated 1.5 km N of Mezní Louka. In the central part the sandstone subgrade is penetrated by cenozoic eruptive rock. Also a small plot under Studený roh rock about 400 metres NE of the borders of Ponova louka was studied.

Alt.: 340–460 m a.s.l.

Coordinates of the centre: 50°53'9.064"N, 14°19'31.248"E.

Dominating tree species: *Fagus sylvatica* (Ponova louka), *Fraxinus excelsior* (Studený roh), *Ulmus glabra* (Studený roh).

Forest community: *Melico-Fagetum*.

Růžák

Nature reserve situated 1.5 km E of Růžová and 1 km W of Srbská Kamenice. The top of the hill is formed of cenozoic volcanic rock.

Alt.: 320–619 m a.s.l.

Coordinates of the centre: 50°50'0.11"N, 14°19'50.741"E.

Dominating wood species: *Acer pseudoplatanus*, *Fraxinus excelsior*, *Fagus sylvatica*, *Ulmus glabra*.

Forest community: *Mercuriali-Fraxinetum*, *Melico-Fagetum*.

Suchá Bělá

This locality follows the seasonal stream which springs on a plateau c. 4 km NE of Hřensko. It has created a deep valley in the sandstone rocks under the influence of long-term erosion.

Alt.: 260–460 m a.s.l.

Coordinates of the centre: 50°53'30.083"N, 14°16'3.129"E.

Dominating wood species: *Fagus sylvatica*.

Forest community: *Luzulo-Fagetum*.

RESULTS AND DISCUSSION

Species spectrum of selected groups of Ascomycetes in the area studied

A total number of 109 species of selected Ascomycetes groups were found on the studied substrates, 11 of which were found both as teleomorphs and anamorphs. The richest group were pyrenomycetes with ascohymenial development and unitunicate ascus, including 76 species. On the other hand only 8 species of pyrenomycetes with ascolocular development and bitunicate ascus were found. The richest genus was *Lasiosphaeria* with altogether 10 species. The second richest genus was *Chaetosphaeria* with 6 species; 3 of them were found frequently in most of the studied localities. The occurrence of perithecia of *Chaetosphaeria pulviscula* prevailed over the reported colonies of its *Menispora caesia* anamorph and the fungus was by far the most common non-stromatic pyrenomycete. The species was confirmed to occur at all studied localities on decorticated wood of a wide spectrum of deciduous trees; no specific ecological demands could be discovered. *Chaetosphaeria innumera* and *Chaetosphaeria ovoidea* occurred predominantly as anamorphs.

Of bitunicate pyrenomycetes, *Melanomma pulvis-pyrius* and *Capronia pilosella* were the most frequently found species.

A detailed alphabetical list of collected species is given in Tab. 1; for their systematics, refer to Tab. 2.

Tab. 1. List of the collected species.

Note: If both teleomorph and anamorph of one species were collected in the studied area then both morphs are given in one row of the table (teleomorph name is mentioned as the first). Large letters „A“ (anamorph) and „T“ (teleomorph) in columns „Host“ and „Locality“ refers to the occurrence of each morph.

Abbreviations: Ac sp. = *Acer* sp., Ac pl = *Acer platanoides*, Ac ps = *Acer pseudoplatanus*, Aes = *Aesculus hippocastanum*, Al = *Alnus* sp., Be = *Betula pendula*, Ca = *Carpinus betulus*, Co = *Corylus avellana*, dt = unidentified deciduous tree, Fa = *Fagus sylvatica*, Fx = *Fraxinus excelsior*, Pc = *Picea abies*, Pi = *Pinus sylvestris*, Qr = *Quercus* sp., So = *Sorbus aucuparia*, Ti = *Tilia cordata*, Ul = *Ulmus glabra*.

Species	Host	Locality
<i>Anthostoma turgidum</i> (Pers.) Nitschke	Fa	Suchá Bělá
<i>Apiorhynchostoma altipetum</i> (Peck) Rappaz	Pi	Babylon
<i>Apiorhynchostoma curreyi</i> (Rabenh.) E. Müll.	Pc, Pi	Babylon, Kamenice valley, Kyjovské valley
<i>Bertia moriformis</i> (Tode) De Not.	Pc, Ac sp.	Babylon, Růžák
<i>Bispora antennata</i> (Pers.) Mason	Fa	Koliště, Ponova louka
<i>Blistum ovalisporum</i> anamorph of <i>Byssostilbe stilbigera</i> (Berk. & Broome) Petch	myxomycete	Suchá Bělá
<i>Brachysporium bloxami</i> (Cooke) Sacc.	Fa	Borový důl, Český vrch, Suchá Bělá
<i>Brachysporium obovatum</i> Keissl.	Ac sp., Fx	Mlýny, Růžák
<i>Barbatosphaeria barbistrostris</i> (Dufour) Réblová	Fa	Borový důl, Koliště
<i>Camarops polysperma</i> (Mont.) J. H. Mill.	Al	Kamenice valley
<i>Camarops pugillus</i> (Schwein.) Shear	Fa	Suchá Bělá
<i>Camarops tubulina</i> (Alb. & Schwein.) Shear	Pc	Kamenice valley
<i>Capronia pilosella</i> (P. Karst.) E. Müll., Petrini, P. J. Fisher, Samuels & Rossman	Fa, Fx	Mlýny, Růžák, Suchá Bělá
<i>Capronia semimmensa</i> (Candoussau & Sulmont) Untereiner & Naveau	Fx, So	Růžák
<i>Cephalotheca purpurea</i> (Shear) Chesters	Fa	Suchá Bělá
<i>Ceratosphaeria rhenana</i> (Auersw.) Berl. & Voglino	dt	Růžák
<i>Ceratostomella cuspidata</i> (Fr.: Fr.) Réblová	Fa	Růžák, Suchá Bělá
<i>Ceratostomella rostrata</i> (Tode: Fr.) Sacc.	Fa, <i>Fomes</i> sp.	Kamenice valley, Růžák, Suchá Bělá
<i>Cercophora caudata</i> (Curr.) N. Lundq.	Ac pl, Ac sp., Be, Fa, Ti	Babylon, Český vrch, Koliště, Růžák
<i>Chaetosphaerella phaeostroma</i> (Durieu & Mont.) E. Müll. & C. Booth + <i>Oedemuim minus</i> anamorph	Fa (A), Fx (T + A)	Český vrch (A), Růžák (T+A)
<i>Chaetosphaeria acutata</i> Réblová & W. Gams + <i>Cylindrotrichum</i> anamorph	Fa (T+A)	Borový důl (T), Suchá Bělá (T+A)
<i>Chaetosphaeria decastyla</i> (Cooke) Réblová & W. Gams + <i>Cacumisporium capitulatum</i> anamorph	Ca (A), Fa (T+A), Fx (T), dt (T+A)	Borový důl (T), Kamenice valley (A), Koliště (T), Růžák (T+A)
<i>Chaetosphaeria innumera</i> Berk. & Broome ex Tul. & C. Tul. + <i>Chloridium botryoideum</i> anamorph	Be (A), Fa (T+A), Fx (T+A), So (T), dt (A)	Babylon (A), Český vrch (T), Kamenice valley (T), Koliště (A), Růžák (T+A), Suchá Bělá (T+A)
<i>Chaetosphaeria myriocarpa</i> C. Booth	Ac sp., Fa, Ca	Kamenice valley, Koliště, Mlýny, Růžák, Suchá Bělá
<i>Chaetosphaeria ovoidea</i> (Fr.) Constant., K. Holm & L. Holm + <i>Menispora glauca</i> anamorph	Be (T), Ca (A), Fa (T+A), Fx (T+A)	Český vrch (A), Kamenice valley (T+A), Koliště (T+A), Kyjovské valley (A), Mlýny (T+A), Ponova louka (T+A), Růžák (T+A), Suchá Bělá (T+A)
<i>Chaetosphaeria pulviscula</i> (Currey) C. Booth + <i>Menispora caesia</i> anamorph	Ac sp. (T), Aes (T), Be (T), Fa (T+A), Fx (T), Ul (T)	Borový důl (T+A), Kamenice valley (T), Koliště (T), Mlýny (T), Ponova louka (T), Růžák (T), Suchá Bělá (T)
<i>Coniochaeta ligniaria</i> (Grev.) Massee	Fa	Suchá Bělá
<i>Coniochaeta velutina</i> (Fuckel) Cooke	Ca, Fa, Ul	Kamenice valley, Mlýny, Ponova louka, Růžák

Species	Host	Locality
<i>Cordana pauciseptata</i> Preuss	Fa	Ponova louka
<i>Crassochaeta fusispora</i> (Sivan.) Réblová	Ac pl	Růžák
<i>Cryptadelphina groenendalensis</i> (Sacc., E. Bomm. & M. Rouss.) Réblová & Seifert + <i>Brachysporium nigrum</i> anamorph	Ac sp. (T+A), Aes (A), Fa (T+A), Fx (T+A), Ul (A)	Český vrch (T+A), Koliště (A), Mlýny (T+A), Ponova louka (A), Růžák (A), Suchá Bělá (T+A)
<i>Cucurbitaria obducens</i> (Schumach.) Petr.	Fx	Růžák
<i>Dactylaria chrysosperma</i> (Sacc.) G.C. Bhatt & W. B. Kendr.	Fa	Suchá Bělá
<i>Diaporthe impulsiva</i> (Cooke & Peck) Sacc.	So	Kyjovské valley, Růžák
<i>Diatrype flavovirens</i> (Pers.) Tul. & C. Tul.	Aes, Fa, Fx, Qr	Borový důl, Český vrch, Mlýny, Ponova louka
<i>Diatrypella favacea</i> (Fr.) Ces. & De Not.	Be, Co, Fa	Český vrch, Kyjovské valley, Růžák, Suchá Bělá
<i>Dictyosporium toruloides</i> (Corda) Guég.	Fa	Český vrch
<i>Diplococcium spicatum</i> Grove	So	Kyjovské valley
<i>Endophragmiella biseptata</i> (Peck) S. Hughes	Pc	Kyjovské valley
<i>Endoxyla macrostoma</i> Fuckel	Pc, Pi	Babylon, Kyjovské valley
<i>Endoxyla operculata</i> (Fr.: Fr.) Sacc.	Pi	Babylon
<i>Endoxyla parallela</i> (Fr.) Sacc.	Pc, Pi	Babylon, Borový důl, Kyjovské valley
<i>Eutypa lata</i> (Pers.) Tul. & C. Tul.	Ac ps, Fa, Fx	Koliště, Kyjovské valley, Růžák
<i>Eutypella quaternata</i> (Pers.) Rappaz + <i>Libertella faginea</i> anamorph	Fa (T+A)	Růžák (T), Suchá Bělá (T+A)
<i>Eutypella sorbi</i> (J.C. Schmidt) Sacc.	So	Růžák
<i>Exosporium tiliae</i> Link	Ti	Český vrch
<i>Gonytrichum chlamydosporium</i> anamorph of <i>Chaetosphaeria chloroconia</i> W. Gams & Hol.-Jech.	Fa, dt	Ponova louka, Růžák
<i>Hypocrea gelatinosa</i> (Tode) Fr.	Ac pl, Ac sp., Fx	Růžák
<i>Hypocrea pulvinata</i> Fuckel	<i>Fomitopsis</i> sp.	Suchá Bělá
<i>Hypocrea rufa</i> (Pers.) Fr.	Fx	Ponova louka
<i>Hypoxyylon cohaerens</i> (Pers.) Fr.	Fa	Český vrch, Koliště, Růžák
<i>Hypoxyylon fragiforme</i> (Pers.) J. Kickx f.	Fa	Kamenice valley
<i>Hypoxyylon howeianum</i> Peck.	Fa	Růžák
<i>Hypoxyylon macrocarpum</i> Pouzar	Ac sp., Ca, Fa, Fx	Český vrch, Ponova louka, Růžák, Suchá Bělá
<i>Hypoxyylon multifforme</i> Fr. (Fr.)	Al, Be	Kamenice valley, Ponova louka
<i>Hypoxyylon rubiginosum</i> (Pers.) Fr.	Ac pl, Fx	Růžák
<i>Kretzschmaria deusta</i> (Hoffm.) P. M. D. Martin	Fa, Ti	Borový důl, Český vrch
<i>Lasiosphaeria canescens</i> (Pers.) P. Karst.	Fa, Fx	Borový důl, Růžák
<i>Lasiosphaeria caudata</i> (Fuckel) Sacc.	Fa	Borový důl
<i>Lasiosphaeria glabrata</i> (Fr.) Munk	Ac sp., Be, Fa, Fx, So, Ti	Borový důl, Český vrch, Kamenice valley, Mlýny, Růžák, Suchá Bělá
<i>Lasiosphaeria hirsuta</i> (Fr.) Ces. & De Not.	Ac sp., Fa, Fx, So	Kamenice valley, Mlýny, Růžák
<i>Lasiosphaeria hispida</i> (Tode) Fuckel	Fa, Fx, So, Ul	Borový důl, Ponova louka, Růžák
<i>Lasiosphaeria immersa</i> P. Karst.	Aes, Ti, Ul	Český vrch, Mlýny, Růžák
<i>Lasiosphaeria ovina</i> (Pers.) Ces. & De Not.	Ac sp., Fa, Fx, So, Ul	Kyjovské valley, Ponova louka, Růžák, Suchá Bělá

Species	Host	Locality
<i>Lasiosphaeria rhacodium</i> (Pers.) Ces. & De Not.	Fa, Fx, So, Ti, dt	Český vrch, Mlýny, Ponova louka, Růžák
<i>Lasiosphaeria spermoides</i> (Hoffm.) Ces. & De Not.	Fa	Kamenice valley, Růžák
<i>Lasiosphaeria strigosa</i> (Alb. & Schwein.) Sacc.	Ac sp., Fx, Ti	Český vrch, Růžák
<i>Lentomitella cirrhosa</i> (Pers.: Fr.) Réblová	Ac sp., Aes, Fa, Fx, Ul	Český vrch, Kamenice valley, Koliště, Mlýny, Ponova louka, Růžák, Suchá Bělá
<i>Lentomitella crinigera</i> (Cooke) Réblová	Pc, Pi	Babylon, Kamenice valley
<i>Lophiostoma nucula</i> (Fr.) Ces. & De Not.	Fx, So	Mlýny
<i>Lophiotrema boreale</i> Math.	Fa	Borový důl, Kamenice valley, Kyjovské valley
<i>Lylea tetracoila</i> (Corda) Hol.-Jech.	Ac sp., <i>Eutypa maura</i>	Český vrch, Ponova louka, Růžák, Suchá Bělá
<i>Melanomma fuscidulum</i> Sacc.	Aes, Fa, So, dt	Koliště, Kyjovské valley, Mlýny, Ponova louka, Růžák
<i>Melanomma pulvis-pyrius</i> (Pers.) Fuckel	Ac sp., Be, Fa, Fx, So, Ti, Ul	Český vrch, Kamenice valley, Koliště, Kyjovské valley, Růžák, Suchá Bělá
<i>Melanopsammella inaequalis</i> (Grove) Höhn. + <i>Gonytrichum caesium</i> anamorph	Fa (A), Pi (T)	Babylon (T), Suchá Bělá (A)
<i>Melanopsammella vermicularioides</i> (Sacc. & Roum.) Réblová, M.E. Barr & Samuels + <i>Chloridium virescens</i> anamorph	Ca (A), Fa (T+A), Fx (T)	Kamenice valley (A), Koliště (A), Růžák (T+A), Suchá Bělá (T+A)
<i>Menispora ciliata</i> Corda	Ac sp., Fa, Fx	Český vrch, Koliště, Ponova louka, Růžák
<i>Monodictys putredinis</i> (Wallr.) Hughes	Fx	Růžák
<i>Nectria coccinea</i> (Pers.) Fr.	Ac sp., Fa, Ul	Růžák, Suchá Bělá
<i>Nectria episphaeria</i> (Tode) Fr.	<i>Diatrype</i> sp., <i>Hypoxyton</i> sp., <i>Hypoxyton fragiforme</i> , <i>Melanomma pulvis-pyrius</i>	Koliště, Růžák, Suchá Bělá
<i>Nectria fuckeliana</i> C. Booth	Pc	Kyjovské valley, Suchá Bělá
<i>Nectria peziza</i> (Tode) Fr.	Fa	Ponova louka, Suchá Bělá
<i>Nemania atropurpurea</i> (Fr.) Pouzar	Ac sp., Fa	Borový důl, Kamenice valley, Růžák
<i>Nemania chestersii</i> (J.D. Rogers & Whalley) Pouzar	Ac pl, Ac sp., Fa, Fx, dt	Kamenice valley, Koliště, Ponova louka, Růžák, Suchá Bělá
<i>Nemania serpens</i> (Pers.) Gray	Ac pl, Ac sp., Fa, Fx, Ti, Ul	Český vrch, Mlýny, Ponova louka, Růžák
<i>Nitschkia cupularis</i> (Pers.) P. Karst.	Fx	Český vrch
<i>Nitschkia parasitans</i> (Schwein.) Nannf.	<i>Nectria</i> sp.	Růžák
<i>Oedemium didymum</i> anamorph of <i>Chaetosphaerella fusca</i> (Fuckel) E. Müll. & C. Booth	Aes, Fx, So	Mlýny, Růžák
<i>Phaeostalagmus cyclosporus</i> (Grove) W. Gams	Ca, Fa	Český vrch, Suchá Bělá
<i>Pleurostoma minimum</i> (Tul. & C. Tul.) M. E. Barr, J. D. Rogers & Y. M. Ju	Fa	Kamenice valley
<i>Pleurothecium recurvatum</i> (Morgan) Höhn.	Ac sp., Fa	Růžák

Species	Host	Locality
<i>Prosthecium platanoidis</i> (Pers.) M. E. Barr	Ac sp.	Kamenice valley, Kyjovské valley
<i>Pseudospiropes hughesii</i> M. B. Ellis	Fa, Fr	Koliště, Ponova louka, Růžák
<i>Pseudospiropes simplex</i> anamorph of <i>Strossmayeria bakeriana</i> (Henn.) Iturr.	Fa, Fx	Růžák
<i>Pseudospiropes subuliferus</i> (Corda) M. B. Ellis	Fa	Koliště
<i>Pseudovalsa lanciformis</i> (Fr.) Ces. & De Not.	Be	Borový důl, Růžák
<i>Quaternaria dissepta</i> (Fr.) Tul. & C. Tul.	Ul	Mlýny
<i>Rhamphoria pyriformis</i> (Pers.) Höhn.	Fa, Fx	Mlýny, Suchá Bělá
<i>Rosellinia aquila</i> (Fr.) Ces. & De Not.	Fx, Ul	Růžák
<i>Spadicoides bina</i> (Corda) Hughes	Fa	Mlýny, Suchá Bělá
<i>Spadicoides grovei</i> M. B. Ellis	Fa	Borový důl, Suchá Bělá
<i>Sporidesmium folliculatum</i> (Corda) E. W. Mason & S. Hughes	Fa, Fx, So, dt	Český vrch, Mlýny
<i>Sporidesmium pedunculatum</i> (Peck) M. B. Ellis	Pc	Kamenice valley
<i>Sporoschisma mirabile</i> Berk. & Broome	So	Růžák
<i>Togniniella acerosa</i> Réblová, L. Mostert, W. Gams & Crous	Fa	Kamenice valley, Suchá Bělá
<i>Tubeufia cerea</i> (Berk. & M. A. Curtis) Höhn. + <i>Helicosporium vegetum</i> anamorph	Ac sp. (A), Aes (A), Fa (A), <i>Diatrype</i> sp. (T), <i>Eutypa maura</i> (T)	Český vrch, Růžák
<i>Valsa ambiens</i> (Pers.) Fr.	Fa	Borový důl, Růžák
<i>Xylaria longipes</i> Nitschke	Ac pl, Ac sp., Fa, Fx	Růžák
<i>Xylomelasma sordidum</i> Réblová	Fa	Borový důl, Suchá Bělá

Tab. 2. Overview of subclasses and orders of the collected species.

Subclass	Order	Number of species
Dothideomycetidae	<i>Dothideales</i>	1
Hypocreomycetidae	<i>Coronophorales</i>	6
	<i>Hypocreales</i>	8
Chaetothyriomycetidae	<i>Chaetothyriales</i>	2
Leotiomycetidae	<i>Helotiales</i>	1
Pleosporomycetidae	<i>Pleosporales</i>	6
Sordariomycetidae	<i>Boloniales</i>	8
	<i>Calosphaeriales</i>	2
	<i>Coniochaetales</i>	2
	<i>Diaporthales</i>	4
	<i>Chaetosphaeriales</i>	11
	<i>Sordariales</i>	18
	Incertae sedis	4
Xylariomycetidae	<i>Xylariales</i>	20
Incertae sedis	<i>Trichosphaeriales</i>	1
	Incertae sedis	2
Anamorphic Ascomycetes		13

Evaluation of lignicolous pyrenomycetes and their anamorphs at individual localities

The territory of the Bohemian Switzerland National Park appeared to be a very promising area for the occurrence of lignicolous pyrenomycetes. As for the total number of found species it can be compared with e.g. the Šumava National Park (Prášil and Réblová 1998, Réblová and Prášil 1999). For each studied locality its value from the viewpoint of lignicolous pyrenomycete diversity is summarised.

Babylon

Number of found species: 10.

Rarely found species (species found only at this locality are marked in bold): *Aporhynchostoma altipetum*, *A. curreyi*, *Cercophora caudata*, *Endoxyla macrostoma*, *E. parallela*, ***E. operculata***, ***Melanopsammella inaequalis***.

Evaluation: Lignicolous pyrenomycetes were studied mostly on *Pinus sylvestris*. Although the total number of species found is relatively low, it is a valuable locality. Most of the species are rare and highly host-specialised, typical of natural forests dominated by coniferous trees. The species spectrum is comparable to the species spectrum of similar localities with a dominance of coniferous trees at higher altitudes like Černé and Čertovo lake glacial cirques in Šumava National Park (Prášil and Réblová 1998).

Borový důl

Number of found species: 21.

Rarely found species (species found only at this locality are marked in bold): *Barbatosphaeria barbirostris*, *Chaetosphaeria acutata*, *Endoxyla parallela*, ***Lasiosphaeria caudata***, *Lophiotrema boreale*, *Xylomelasma sordidum*.

Evaluation: With respect to the small territory and low host diversity, the locality possesses a rather high value thanks to the large amount of suitable substrate. Lignicolous pyrenomycetes were collected mostly on lying trunks of *Fagus sylvatica* in advanced stages of decay; non-stromatic species with ascomata buried in soft wood dominated. It was here that the species *Lophiotrema boreale*, so far reported only from Norway (Mathiassen 1986) and Sweden (Holm and Holm 1988), was collected.

Český vrch

Number of found species: 27.

Rarely found species (species found only at this locality are marked in bold): *Cercophora caudata*, ***Dyctiosporium toruloides***, *Lasiosphaeria immersa*, ***Nitschkia cupularis***.

Evaluation: Locality with small area but considerable host variety. Interesting records from this locality include *Exosporium tiliae* specialised on bark of *Tilia* sp. The hill is convenient for occurrence of lignicolous pyrenomycetes mainly in early spring and in autumn because of insufficient humidity during summer.

Kamenice River canyon

Number of found species: 27.

Rarely found species (species found only at this locality are marked in bold): *Aporhynchostoma curreyi*, ***Camarops polysperma***, ***C. tubulina***, *Ceratostomella rostrata*, *Lasiosphaeria spermoides*, *Lophiotrema boreale*, ***Pleurostoma minimum***, ***Sporidesmium pedunculatum***, *Togniniella acerosa*.

Evaluation: The gorges along the Kamenice River are valuable localities mainly due to their cold and humid microclimate, which stays stable during the whole year. Collections of two species new to the Czech Republic originate from this locality (viz. *Togniniella acerosa* and *Lophiotrema boreale*). Also records of two species of the genus *Camarops* are significant, viz. *C. tubulina* and *C. polysperma*. These pyrenomycetes occur in natural forests minimally influenced by forest management and are generally threatened; the first one is included in the Czech and Slovak Red Book, and the Red List and protected by law in the Czech Republic (Kotlaba et al. 1995, Holec 2005, Holec and Beran 2006). There is probably a potential for occurrence of a much wider spectrum of lignicolous pyrenomycetes at this locality, but the main limiting factor is the low amount of dead wood in comparison with other localities; decaying fallen trunks are almost absent. The species spectrum is limited, especially because the wood of the dominant wood species *Picea abies* is occupied by a restricted number of pyrenomycetes.

Koliště

Number of found species: 22.

Rarely found species: *Barbatosphaeria barbistrotris*, *Cercophora caudata*, *Chaetosphaeria decastyla*, *Pseudospiropes subuliferus*.

Evaluation: Except of a few rarely found species given above only species commonly found in this particular habitat (herb-rich beech forests) were registered. The fungi were collected mainly on dead branches and fragments of wood in advanced stages of decay lying in the litter. Just as Český vrch, also this locality is convenient for occurrence of lignicolous pyrenomycetes mainly in early spring and in autumn because of insufficient humidity during summer.

Kyjovské valley

Number of found species: 15.

Rarely found species: *Diplococcium spicatum*, *Endophragmiella biseptata*, *Endoxyla macrostoma*, *E. parallela*, *Lophiotrema boreale*, *Nectria fockeliana*.

Evaluation: The nature of this locality is similar to the Kamenice valley (see above); it is characterised by sufficient humidity and absence of narrow gorges. The occurrence of lignicolous pyrenomycetes is limited by a lack of lying trunks in advanced stages of decay and low host variety, dominance of *Picea abies* and only occasional occurrence of deciduous trees. Several rarely found species were reported, e.g. species of the genus *Endoxyla* specialised on coniferous wood and 2 dematiaceous hyphomycete species (*Diplococcium spicatum*, *Endophragmiella biseptata*).

Mlýny

Number of found species: 27.

Rarely found species (species found only at this locality are marked in bold): *Lasiosphaeria immersa*, ***Lophiostoma nucula***, ***Quaternaria dissepta***, *Rhamphoria pyriformis*, *Spadicoides bina*.

Evaluation: Only a small plot with an ash grove and a few *Aesculus hippocastanum* trees with quite a large mass of fallen decaying wood (branches, parts of trunks) were studied. Especially *A. hippocastanum* has very soft and rapidly decaying wood, suitable for occurrence of saprotrophic pyrenomycetes.

Ponova louka

Number of found species: 29.

Rarely found species: *Gonytrichum chlamydosporium*, *Hypoxylon macrocarpum*.

Evaluation: Except for *Gonytrichum chlamydosporium* (anamorph of *Chaetosphaeria chloroconia*), which was reported from only two localities in the Bohemian Switzerland National Park, many common species, probably widespread across the National Park's territory, were found here. The small research plot under Studený roh rock was characteristic by plenty of fallen trunks of *Ulmus*

glabra and *Fraxinus excelsior*. But despite expectations only ordinary species widespread at other studied localities were recorded. One of the reasons of this situation could be unfavourable microclimatic conditions with insufficient humidity caused by a large open area without trees. This locality turned out to be appropriate for the occurrence of a less common *Hypoxylon* species, *H. macrocarpum*.

Růžák

Number of found species: 72.

Rarely found species (species found only at this locality are marked in bold): ***Capronia semiimmersa***, ***Ceratospaeria rhenana***, *Ceratostomella cuspidata*, *C. rostrata*, *Cercophora caudata*, ***Chaetosphaerella phaeostroma***, ***Crassochaeta fusispora***, ***Cucurbitaria obducens***, ***Hypocrea gelatinosa***, *Lasiosphaeria canescens*, *L. immersa*, *L. spermoides*, *Melanopsammella vermicularioides*, ***Nitschkia parasitans***, ***Rosellinia aquila***, ***Sporoschisma mirabile***.

Evaluation: Very valuable locality mainly due to the well-preserved ravine forest on the hill's slopes with a great variety of microhabitats and hosts. There are many fallen trunks in advanced stages of decay and other wood mass lying in the undergrowth and rich layer of litter. Four species from this locality are reported as new records for the Czech Republic (*viz.* *Capronia semiimmersa*, *Ceratospaeria rhenana*, *Crassochaeta fusispora*, *Nitschkia parasitans*). The number of species found is comparable with valuable localities in the Šumava Mountains (Prášil and Réblová 1998). A more detailed study at this in many ways unique locality would probably reveal an even greater Ascomycetes diversity.

Suchá Bělá

Number of found species: 50.

Rarely found species (species found only at this locality are marked in bold): ***Blistum ovalisporum*** (anamorph of *Byssostilbe stilbigera*), ***Camarops pugillus***, ***Cephalotheca purpurea***, *Ceratostomella cuspidata*, *Ceratostomella rostrata*, *Chaetosphaeria acutata*, ***Coniochaeta ligniaria***, ***Dactylaria chryosperma***, *Gonytrichum caesium* (anamorph of *Melanopsammella inaequalis*), ***Hypocrea pulvinata***, *Melanopsammella vermicularioides*, *Rhamphoria pyriformis*, *Togniniella acerosa*, *Xylomelasma sordidum*.

Evaluation: Very valuable locality with a wide spectrum of species including many rarely found species and 3 species that have not yet been reported from the Czech Republic (*Camarops pugillus*, *Cephalotheca purpurea*, *Togniniella acerosa*). The diversity of the studied fungi is mainly caused by two different habitats (acidophilous beech forest along the middle Suchá Bělá stream which slowly changes into a herb-rich forest on the plateau near the frontier with Germany) and favourable humidity conditions at the locality. Especially in the narrow valley of Suchá Bělá stream the microclimate remains cold and damp all year round. Many of the species found here were also reported from natural beech forests in the Šumava Mts. at an altitude of around 1000 m a.s.l. (e.g. on Mt. Ždanidla – Prášil and Réblová 1998).

Evaluation of lignicolous pyrenomycetes and their anamorphs in relation to the substratum type

Most of the recorded species were polyphagous without host specialisation. Species spectrums on the studied deciduous trees were very similar and overlapped one another. A very specific and entirely different mycoflora was recorded on coniferous wood. This is probably due to the different chemical structure of these two types of wood and different enzymatic equipment of the studied fungi.

The more permanent structure of lignin and higher content of resin in coniferous wood may account for the less frequent and highly specific occurrence of lignicolous pyrenomycetes (e.g. Whalley 1996). Only one species (*Bertia moriformis*) is known to occur on both deciduous and coniferous wood, which is in agreement with literature records. *Endoxyla parallela* and *Melanopsammella inaequalis* are also able to occupy both types of substrates (Gams and Holubová-Jechová 1976, Untereiner 1993).

Considering the type of the substratum, I would like to present several ecological observations of the fungi in relation to the studied localities:

1. In agreement with literature records (e.g. Boddy and Rayner 1984, Griffith and Boddy 1988) fungi on attached and freshly fallen twigs form a highly specialised group with specific ecological demands. In this category a large part of substratum-specific species can be found, e.g. *Eutypella quaternata*, *Prostheciium platanoidis*, and *Pseudovalsa lanciformis*.

2. Another specialised group includes pyrenomycetes and anamorphic ascomycetes growing on old stromata and fruiting bodies of other fungi. According to the literature these species are usually specialised for a certain substratum and in many cases the range of host fungi is strongly limited, e.g. *Nitschkea parasitans* only grows on ascomata of *Nectria* (Hilber et al. 1982–1983), *Blistum ovalisporum* on myxomycetes of the genera *Trichia* and *Hemitrichia* (Ellis and Ellis 1988). Many *Capronia* species are specialised for effuse fruiting bodies of coral fungi (Müller et al. 1987). Occasionally species typical of soft, decaying wood were found on the hymenophores of old polyporous fruiting bodies (e.g. *Ceratostomella rostrata*).

3. A third specialised group is formed by species growing on the inner side of peeled off bark. These species have usually a broader ecological spectrum and many of them occurred also on decaying wood. At least in some of them a preference for bark was obvious, e.g. *Barbatosphaeria barbistrostris* and *Lophiotrema boreale*.

4. Loose wood remnants represent another specific type of substratum for lignicolous pyrenomycetes. This type of substratum comprises fragments of fallen branches and trunks in the litter in advanced stages of decay. Such fragments are usually in contact with the soil, sufficiently damp and very soft. Many species found on this type of substratum colonised complete fallen branches and trunks as well, but for some of them a preference for loose parts of fallen branches and trunks could be noticed, e.g. in *Cryptadelphia groenendalensis* (both teleomorph and anamorph), *Nectria peziza* and *Hypocrea gelatinosa*.

5. The thickness of the substratum (branch vs. trunk) does not seem to be important for the occurrence of lignicolous pyrenomycetes in the studied area. The most important factor is the stage of decay related to the hardness or softness of the wood.

The mycoflora of soft, moist, partially decayed wood is different from the mycoflora of hard, barkless wood. In most of the species mentioned in this paper a preference for one type of substratum was observed; only a few species with broad ecological amplitude occurred on hard as well as decayed wood (viz. *Chaetosphaeria innumera*, *Ch. ovoidea*, *Ch. pulviscula* and *Melanomma fuscidulum*).

Lignicolous pyrenomycetes, forest management and their protection

There is in fact no known document dealing with threatened species of microscopic Ascomycetes. In the Red List of threatened fungi of the Czech Republic only micromycetes with fruiting bodies or stromata larger than 2 mm are included, a group which represents the common scope of field mycologists and is well documented by published and herbarium data (Holec and Beran 2006). According to this document, three of the found species fall into one of a category of threat, see Tab. 3.

Tab. 3. Threatened species according to the Red List of the Czech Republic (Holec and Beran 2006).

Species	Host	Locality	Category of threat
<i>Camarops tubulina</i>	<i>Picea abies</i>	Kamenice valley	near-threatened (NT)
<i>Nemania atropurpurea</i>	<i>Acer</i> sp., <i>Fagus sylvatica</i>	Borový důl, Kamenice valley, Růžák	vulnerable (VU)
<i>Nemania chestersii</i>	<i>Acer platanoides</i> , <i>Acer</i> sp., <i>Fagus sylvatica</i> , <i>Fraxinus excelsior</i>	Kamenice valley, Koliště, Ponova louka, Růžák, Suchá Bělá	endangered (EN)

The real degree of threat and distribution of *C. tubulina* in the Czech Republic is in detail discussed in Holec (2005). Other finds of this species from the Bohemian Switzerland National Park are mentioned in this study.

Regarding the studied area, the two species of *Nemania* do not seem to be threatened, although listed in the Red List of the Czech Republic. Especially *N. chestersii* was repeatedly recorded from five localities without observing any special requirements for the host wood, which could be a factor limiting its distribution. I would expect these two species to occur in more or less natural forest stands with presence of decaying deciduous trunks or thick branches. Stable humidity of the locality and substrate is also important – this is best ensured by a closed forest stand with rich undergrowth without cutting activities at the site and without deforested areas surrounding it.

The *Boliniaceae* include some rare and interesting species collected in this area, e.g. *Camarops pugillus* and *C. polysperma*. The former species was found in the Czech Republic for the first time. It occurred in early spring on a damp decayed beech branch partly covered in litter in a deep valley of the Suchá Bělá stream. Its occurrence seems to be related to the presence of natural deciduous

forest with a stable cold microclimate where the substrate remains damp for the whole year, including summer. These conditions are usually provided in places with climatic inversion and at higher altitudes. *Camarops polysperma* occurs scattered across Europe (Hilber and Hilber 1980, Hansen and Knudsen 2000, Nannfeldt 1972), mainly on *Alnus glutinosa* nearby water streams. For this reason it is threatened by regulations of streams, drainage and relating damage of alluvial forests.

In the case of microscopic species (fruiting bodies smaller than 2 mm) the evaluation of threat or assessment of their rarity is very difficult because of insufficient field data. Since the size of their fruiting bodies often does not even reach 500 µm they are usually invisible to the untrained eyes. Therefore, drawing serious conclusions would demand a more detailed and longer lasting study. However, there are several general locality features and recommendations for forest management that provide preconditions for an occurrence of a wide spectrum of lignicolous pyrenomycetes:

1. Sufficient amount of fallen trunks and remnants of wood left to spontaneous decomposition (this is usually the rule in first zones of the National Park but some fallen trunks should be left also in man-made forest cultures).

2. Stable and sufficient humidity at the locality ensured by a closed forest stand with rich undergrowth, possibly also by presence of a water stream (cutting at and nearby the locality should be avoided; relicts of natural forests that are refuges of rare species should not be fragmented).

3. Species and age variety of host trees (support of natural regeneration of autochthonous species, increasing the share of deciduous trees in spruce monocultures).

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