

Mycoflora of beech forests in the Kremnické vrchy Mts (Central Slovakia)

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Abstract

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The results of myco-inventory research from the Ecological-Experimental Stationary (EES) Kremnické vrchy mountains (Central Slovakia) are presented. The locality is situated within the beech forests. Total 353 species of fungi were determined on the EES locality. The species eg *Coenococcum geophilum*, *Habrostictis rubra*, *Nectria punicea*, *Sphaerostibella aureonitens* (Ascomycota) as well as *Hymenogaster olivaceus*, *Mycena stipitata*, *Phaeocollybia festiva*, *Pseudotomentella tristis* (Basidiomycota) and *Cryptococcus podzolicus* (Cystofilobazidiales) are rare and endangered. Both of thermophilous and typical mountain species of macromycetes were found. The ecotropical distribution of species spectrum is presented. A few species were found as the lignicolous parasites, herboparasites or mycoparasites.

Key words

beech forests, Central Slovakia, Kremnické vrchy mountains, mycocoenology, mycoflora

Introduction

The Kremnické vrchy Mts, with their varied geology and geo-morphology, are an important volcanic mountain range belonging to the unit Slovenské stredohorie Mts. Forest complexes in the Kremnické vrchy Mts have a much diversified species composition, and they represent almost all vegetation tiers. All up-to-date recognised specific properties of this area also reflect the very high diversity of the local biota. In the Kremnické vrchy Mts, we can meet a number of members of thermophilous Pannonian flora as well as members preferring cold conditions. It is undisputable that the species diversity of biota in the Kremnické vrchy Mts is also manifested by the mycoflora over this mountain range. We studied mycoflora in beech forest ecosystems in a selected locality situated in southern part of the Kremnické vrchy Mts.

The history of mycological research in area of the Kremnické vrchy Mts points out a lack of systematic study – in contrast to the close Štiavnické vrchy Mts. From the far past, we have the first records of

mycoflora in the Kremnické vrchy Mts registered by HAZSLINSKÝ (1886), who studied here a selected group of ascomycetous fungi. SVRČEK (1965) in his survey of mycofloristic research in individual phyto-geographical districts reports in case of the Kremnické vrchy Mts two authors only: KOTLABA – Poštárka u Zvolena (September 1954, Aphylloporales) and ČERNÝ – Budča (Polyporales). More interest in mycoflora in the Kremnické vrchy Mts can be dated to 80s of the past century. KOTLABA (1984) presents about 50 species of polyporous fungi recorded in the Kremnické vrchy Mts. KOTLABA (1991-in litt.) collected fungi in this region also in years 1973 (National Nature reserve Badínsky prales, virgin forest) and in 1986 (National Nature Reserve Mláčik). Also other published works of this author (KOTLABA, 1995; KOTLABA and POUZAR, 1963) mention several macromycetes species collected in the Kremnické vrchy Mts. Several other authors also included in their works fungal species recorded in the Kremnické vrchy Mts, eg HAGARA (1987, 1992), KUBIČKA and LIZOŇ (1982), LIZOŇ (1991), ŠKUBLA (1995).

Since 1990 we have been carrying out a research on mycoflora in southern part of the Kremnické vrchy Mts. From the examined area we have collected a large number of the newest mycofloristic records, and we have also published several mycocoenological papers (eg MIHÁL, 1993, 1996a, b, 1998, 2002; MIHÁL and BUČINOVÁ, 2005, 2007). In this paper we summarise the species diversity of hitherto recorded macromycetes in beech stands in southern part of the Kremnické vrchy Mts.

Materials and methods

We studied mycoflora in beech stands in south part of the Kremnické vrchy Mts. The research ran at the Ecological Experimental Stationary (EES) Kováčová – Kremnické vrchy Mts, from 1990 to 2008. The research station was established in year 1989, by investigators working at the Institute of Forest Ecology SAS in Zvolen. The aim was long-term monitoring of changes in biotic and abiotic components of fir-beech ecosystems subjected to human-induced load at different levels. We visited the locality once-monthly, at least, in vegetation season – from April to November. The short description of the locality EES Kremnické vrchy Mts is in Table 1.

During each visit to the locality we made records about the species diversity of macromycetes. Material that had not been determined directly in field was

determined in the laboratory, following the literature: ČERVENKA et al. (1972), MOSER (1983), JULICH (1984), BREITENBACH and KRÄNZLIN (1986), HAGARA (1987, 1992), VESELÝ et al. (1972), PAPOUŠEK (2004), and other sources. Several species were determined in laboratory *in vitro* conditions, by cultivation on substrates and by using sequencing analysis of sequences obtained from clones cultivated from nrDNA templates. From DNA templates isolated from soil samples, we amplified fragments of nuclear ribosomic acid nrDNA, by means of polymerase chain reaction – PCR in presence of primers specific for fungi (GRYNDLER et al., 2004). More detailed description of this method can be found in BUČINOVÁ (2008).

Herbarium items for most species are deposited by the first author in the Institute of Forest Ecology SAS in Zvolen. For assessment of mycocoenological situation, the species diversity was divided in two basic ecotrophic groups: 1. wood-decaying fungi (parasites and saprophytes), growing in wood substrate only, 2. terrestrial species (mycorrhizal and saprophytic), growing from soil horizons and forest litter. Apart from these two basic ecological trophic groups, we classified certain species in separate group of myco-parasitic species (species parasitizing on other fungi) and phyto-parasitic species (parasitizing on leaves of herbs and woody plants). In the group of epiphytic fungi we classified one single species (*Ascodichaena rugosa*).

Table 1. Basic characteristics of the locality EES Kremnické vrchy Mts

Orographic unit	Kremnické vrchy Mts
Permanent research plot	Ecological – Experimental Stationary Kováčová
Localisation	N 48°38'10", E 19°04'08"
Altitude [m asl.]	470–490
Exposition	WSW
Slope [°]	20
Geological substrate	Andesite, tuffaceous agglomerates
Soil type	Cambisol modale saturated
Throughfall *[mm]	653
Temperature * [°C]	8.3
Forest type groups	<i>Fagetum pauper inferiora</i>
Vegetal association	<i>Dentario bulbiferae</i> – Fagetum Zlatník, 1936 <i>Carici pilosae</i> – Fagetum Oberd. 1958
Tree composition [%]	Beech 95, fir 2, hornbeam 2, oak 1
Age of stand [years]	105
Stocking of stand **	0.0–0.3–0.5–0.7–0.9
Crown canopy [%]	0.0–100
Area of EES [ha ⁻¹] **	1.61

*Throughfall and Temperature: average values from 2003–2005 (Source: SHMÚ 2007)

**Stocking and Area of individual Partial research plots (PP): PP: H (clear cut) – 0.0–0.41 ha⁻¹, PP: I (intensive cutting operation) – 0.3–0.35 ha⁻¹, PP: S (mediate cutting operation) – 0.5–0.35 ha⁻¹, PP: M (moderate cutting operation) – 0.7–0.35 ha⁻¹, PP: K (control plot – without cutting operation) – 0.9–0.15 ha⁻¹

Results and discussion

In the following overview list we describe all hitherto determined fungal species confirmed for the EES Kremnické vrchy Mts. The species are ordered alphabetically: Ascomycota, Basidiomycota, Deuteromycota – Fungi imperfecti and Cystofilobasidiales. The nomenclature and author's abbreviations for taxons have been presented by LIZOŇ and BACIGÁLOVÁ (1998) and ŠKUBLA (2003).

Ascomycota: (46 species)

Aleuria aurantia (Pers.) Fuckel, *Ascocoryne sarcoides* (Jacq.) J.W. Groves et D.E. Wilson, *Ascodichaena rugosa* (L.) Butin, *Bisporella citrina* (Batsch) Korf et S.E.Carp., *Cenococcum geophilum* Fr., *Dasyscyphus ciliatus* (Schrad.) Sacc., *Diatrype disciformis* (Hoffm.) Fr., *D. stigma* (Hoffm.) Fr., *Durella commutata* Fuckel, *Eutypella quaternata* (Pers.) Rappaz, *Gyromitra esculenta* (Pers.) Fr., *Habrostictis rubra* Fuckel, *Helvella elastica* Bull., *H. lacunosa* Afzel., *Humaria hemisphaerica* (F.H.Wigg.) Fuckel, *Hymenoscyphus fagineus* (Pers.) Dennis, *Hypomyces chrysospermus* Tul. et C.Tul., *H. luteovirens* (Fr.) Tul. et C.Tul., *Hypoxylon fragiforme* (Pers.) J.Kickx f., *H. multifforme* (Fr.) Fr., *Kretzschmaria deusta* (Hoffm.) P.M.D.Martin, *Lachnum roseum* (Rehm) Rehm, *Leotia lubrica* (Scop.) Pers., *Melanopsamma pomiformis* (Pers.) Sacc., *Microsphaera alphitoides* Griffiths et Maubl., *Nectria cinnabarina* (Tode) Fr., *N. cosmariospora* Ces. et De Not., *N. ditissima* Tul. et C.Tul., *N. episphaeria* (Tode) Fr., *N. galligena* Bres. apud Strasser, *N. peziza* (Tode) Fr., *N. purtonii* (Grev.) Berk., *N. radiculicola* Gerlach & L.Nilsson, *Orbilbia curvatispora* Boud., *O. luteorubella* (Nyl.) P. Karst., *Peziza arvernensis* Boud., *P. succosa* Berk., *Pseudoplectania melaena* (Fr.) Sacc., *Pseudovalsa spinifera* (Wallr.) E.M.Barr., *Rhytisma acerinum* (Pers.) Fr., *Scutellinia scutellata* (L.) Lambotte, *Spathularia flavida* Pers., *Sphaerostibella aureonitens* (Tul. et C.Tul.) Seifert et al., *Valsa ambiens* (Pers.) Fr., *Xylaria hypoxylon* (L.) Grev., *X. polymorpha* (Pers. ex Mérat) Grev.

Basidiomycota: (300 species)

Agaricus arvensis Schaeff., *A. silvaticus* Schaeff., *Agrocybe praecox* (Pers.) Fayod, *Amanita eliae* Quél., *A. pantherina* (DC.) Krombh., *A. phalloides* (Fr.) Link, *A. rubescens* Pers., *A. vaginata* (Bull.) Lam., *Armillaria ostoyae* (Romagn.) Herink, *Auricularia mesenterica* (Dicks.) Pers., *Basidioradulum radula* (Fr.) Nobles, *Bjerkandera adusta* (Willd.) P. Karst., *Boletus betulicola* (Vasilkov) Pilát et Dermek, *B. edulis* Bull., *B. erythropus* Pers., *B. regius* Krombh., *B. reticulatus* Schaeff., *B. subappendiculatus* Dermek et al., *Bovista pussilla* (Batsch) Pers., *Calocera cornea* (Batsch) Fr., *C. viscosa* (Pers.) Fr., *Calvatia excipuliformis* (Scop.) Perdeck,

Cantharellus cibarius Fr., *C. pallens* Pilát, *C. tubaeformis* Fr., *Chondrostereum purpureum* (Pers.) Pouzar, *Chrysomphalina chrysophyllum* (Fr.) Cléménçon, *Clavariadelphus pistillaris* (L.) Donk., *Clavicornona pyxidata* (Pers.) Donk, *Clavulina cinerea* (Bull.) J. Schröt., *C. coralloides* (L.) J. Schröt., *Climacocystis borealis* (Fr.) Kotl. et Pouzar, *Clitocybe alba* (Bat.) Sing., *C. fragrans* (Sowerby) P.Kumm., *C. gibba* (Pers.) P.Kumm., *C. metachroa* (Fr.) P.Kumm., *C. nebularis* (Batsch.) P.Kumm., *C. odora* (Bull.) P.Kumm., *C. phyllophila* (Pers.) P.Kumm., *Clitopilus prunulus* (Scop.) P.Kumm., *Coleosporium tussilaginis* (Pers.) Berk., *Collybia cookei* (Bres.) J.D.Arnold, *Conocybe aporos* Kits van Waw., *Coprinus comatus* (O.F.Müll.) Gray, *C. disseminatus* (Pers.) Gray, *C. domesticus* (Bolton) Gray, *C. micaceus* (Bull.) Fr., *C. plicatilis* (Curt.) Fr., *C. silvaticus* Peck, *C. xanthothrix* Romagn., *Cortinarius anomalus* (Fr.) Fr., *C. brunneus* (Pers.) Fr., *C. bulliardii* (Pers.) Fr., *C. duracinus* Fr., *C. multifformis* (Fr.) Fr., *C. venetus* var. *montanus* M.M.Moser, *Craterellus cornucopioides* (L.) Pers., *Creolophus cirrhatus* (Pers.) P.Karst., *Cyathus striatus* (Huds.) Willd., *Cystoderma carcharias* (Pers.) Fayod, *C. cinnabarinum* (Alb. et Schwein. ex Fr.) Fayod, *C. granulosum* (Batsch) Fayod, *Dacrymyces stillatus* Nees., *Daedalea quercina* (L.) Fr., *Daedaleopsis confragosa* (Bolton) J.Schröt., *Entoloma rhodopolium* f. *nidorosum* (Fr.) Noordel., *E. sinuatum* (Bull. ex Fr.) P.Kumm., *Exidia glandulosa* (Bull.) Fr., *E. saccharina* (Alb. et Schwein.) Fr., *E. pithya* (Alb. et Schwein.) Fr., *Flammulina velutipes* (M.A.Curtis) Singer, *Fomes fomentarius* (L.) J.Kickx f., *Fomitopsis pinicola* (Sw.) P.Karst., *Galerina badipes* (Fr.) Kühner, *G. pumila* (Pers.) Singer, *Ganoderma lipsiense* (Batsch) G.F.Atk., *G. lucidum* (M.A.Curtin) P.Karst., *Geastrum fimbriatum* Fr., *Gloeophyllum abietinum* (Bull.) P. Karst., *G. odoratum* (Wulfen) Imazeki, *Gymnopilus junonius* (Fr.) P.D.Orton, *G. penetrans* (Fr.) Murrill, *G. sapineus* (Fr.) Maire, *Gymnopus acervatus* (Fr.) Murrill, *G. aquosus* (Bull.) Antonín et al., *G. confluens* (Pers.) Antonín et al., *G. dryophilus* (Bull.) Murrill, *G. fusipes* (Bull.) Gray, *G. peronatus* (Bolton) Antonín et al., *Hapalopilus nidulans* (Fr.) P.Karst., *Hebeloma radicosum* (Bull.) Ricken, *H. sinapizans* (Paulet) Gillet, *Hericium clathroides* (Pall.) Pers., *H. coralloides* (Scop.) Gray, *Heterobasidion annosum* (Fr.) Bref., *Hirneola auricula-judae* (Bull.) Berk., *Hohenbuehelia petaloides* (Bull.) Schulzer, *Hydnum repandum* L., *H. rufescens* Fr., *Hydropus subalpinus* (Höhn.) Singer, *Hygrophoropsis aurantiaca* (Wulfen) Maire, *Hygrophorus chrysodon* (Batsch) Fr., *H. eburneus* (Bull.) Fr., *H. penarius* Fr., *H. poetarum* R.Heim, *H. olivaceoalbus* (Fr.) Fr., *Hymenochaete rubiginosa* (J.Dicks.) Lév., *Hymenogaster olivaceus* Vittad., *Hypholoma fasciculare* (Huds.) P.Kumm., *H. sublateralitium* (Schaeff.) Quél., *Inocybe asterospora* Quél. *I. geophylla* (Fr.) P.Kumm., *I. rimoso* (Bull.) P.Kumm., *Inonotus nodulosus* (Fr.) P.Karst., *Kuehneromyces*

mutabilis (Schaeff.) Singer et A.H.Sm., **Laccaria** *amethystina* (Huds.) Cooke, *L. laccata* agg., *L. proxima* (Boud.) Pat., **Lacrymaria** *lacrymabunda* (Bull.) Pat., **Lactarius** *azonites* (Bull.) Fr., *L. blennius* (Fr.) Fr., *L. chrysorrheus* Fr., *L. fuliginosus* (Fr.) Fr., *L. mitissimus* (Fr.) Fr., *L. pallidus* (Pers.) Fr., *L. piperatus* (L.) Gray, *L. pterosporus* Romagn., *L. quietus* (Fr.) Fr., *L. salmonicolor* R.Heim et Leclair, *L. torminosus* (Scaeff.) Gray, *L. vellereus* (Fr.) Fr., *L. volemus* (Fr.) Fr., *L. zonarius* (Bull.) Fr., **Leccinum** *carpini* (R.Schulz) M.M.Moser ex D.A.Reid, *L. scabrum* (Bull.) Gray, **Lentaria** *mucida* (Pers.) Corner, **Lentinus** *strigosus* (Schwein.) Fr., *L. torulosus* (Pers.) Lloyd, **Lenzites** *betulina* (L.) Fr., **Lepiota** *clypeolaria* (Bull.) P.Kumm., *L. cristata* (Alb. et Schwein.) P.Kumm., **Lepista** *flaccida* (Sowerby) Pat., *L. irina* (Fr.) H.E.Bigelow, *L. nuda* (Bull.) Cooke, *L. panaeolus* (Fr.) P. Karst., **Leucopaxillus** *giganteus* (Sibth.) Singer, **Lycoperdon** *echinatum* Pers., *L. perlatum* Pers., *L. pyriforme* Schaeff., *L. umbrinum* Pers., **Lycophyllum** *connatum* (Schumach.) Singer, *L. deliberatum* (Britzelm.) Kreisel, *L. fumosum* (Pers.) P.D.Orton, *L. loricatum* (Fr.) Kühner, **Macrocyttidia** *cucumis* (Pers.) Joss., **Macrolepiota** *procera* (Scop.) Singer, **Marasmiellus** *foetidus* (Sowerby) Antonín et al., **Marasmius** *alliaceus* (Jacq.) Fr., *M. bulliardii* Quél., *M. cohaerens* (Pers.) Cooke et Quél., *M. epiphyllus* (Pers.) Fr., *M. rotula* (Scop.) Fr., *M. wynnei* Berk et Broome, **Megacollybia** *platyphylla* (Pers.) Kotl. et Pouzar, **Mycena** *acicula* (Schaeff.) P.Kumm., *M. alcalina* (Fr.) P.Kumm., *M. citrinomarginata* Gillet, *M. crocata* (Schrad.) P.Kumm., *M. epipterygia* (Scop.) Gray, *M. fagetorum* (Fr.) Gillet, *M. filopes* (Bull.) P.Kumm., *M. galericulata* (Scop.) Gray, *M. galopus* (Pers.) P.Kumm., *M. haematopus* (Pers.) P. Kumm., *M. maculata* P.Karst., *M. polygramma* (Bull.) Gray, *M. pura* (Pers.) P.Kumm., *M. renati* Quél., *M. rosea* (Bull.) Gramberg, *M. rosella* (Fr.) P.Kumm., *M. stipata* Maas Geest. & Schwöbel, *M. stylobates* (Pers.) P.Kumm., **Oligoporus** *subcaesius* (A.David) Ryvarden et Gilb., *O. fragilis* (Fr.) Gilb. et Ryvarden, *O. stipticus* (Pers.) Gilb. et Ryvarden, *O. tephroleucus* (Fr.) Gilb. et Ryvarden, **Omphalina** *epichysium* (Pers.) Quél., **Oudemansiella** *mucida* (Schrad.) Höhn., **Panaeolus** *retirugis* (Fr.) Quél., **Panellus** *serotinus* (Pers.) Kühner, *P. stipticus* (Bull.) P.Karst., **Paxillus** *involutus* (Batsch) Fr., **Peniophora** *incarnata* (Pers.) P.Karst., **Phaeocollybia** *festiva* (Fr.) Heim., **Phaeolus** *schweinitzii* (Fr.) Pat., **Phaeomarasmius** *erinaceus* (Fr.) Kühner, **Phallus** *impudicus* L., **Phanerochaete** *laevis* (Pers.) J. Erikss. et Ryvarden, **Phellinus** *conchatus* (Pers.) Quél., *P. hartigii* (Allesch. et Schnabl) Pat., **Phlebia** *radiata* Fr., **Phlebiella** *sulphurea* (Pers.) Ginus et M.N.L. Lefébvre, **Pholiota** *adiposa* (Batsch) P. Kumm., *P. aurivella* (Batsch) P.Kumm., *P. flammans* (Batsch) P.Kumm., *P. lenta* (Pers.) Singer, *P. squarrosa* (Weigel) P.Kumm., **Phragmidium** *rubi-idaei* (DC.) P.Karst., **Pleurotus** *ostreatus* (Jacq.) P.Kumm., *P. pulmonarius* (Fr.) Quél., **Plicaturopsis** *crispa* (Pers.) D.A.Reid, **Pluteus**

atromarginatus (Konrad) Kühner, *P. cervinus* (Schaeff.) P.Kumm., *P. pellitus* (Pers.) P.Kumm., *P. romellii* (Britzelm.) Sacc., *P. salicinus* (Pers.) P.Kumm., **Polyporus** *arcularius* (Batsch) Fr., *P. brumalis* (Pers.) Fr., *P. ciliatus* Fr., *P. melanopus* (Sw.) Fr., *P. squamosus* (Huds.) Fr., *P. varius* (Pers.) Fr., **Psathyrella** *candolleana* (Fr.) Maire, *P. piluliformis* (Bull.) P.D.Orton, *P. spadiceogrisea* (Schaeff.) Maire, **Pseudoclitocybe** *cyathiformis* (Bull.) Singer, **Pseudocraterellus** *undulatus* (Pers.) Rauschert, **Pseudohydnum** *gelatinosum* (Scop.) P.Karst., **Pseudotomentella** *tristis* (P.Karst.) M.J.Larsen, **Psilocybe** *inquilina* var. *crochula* (Fr.) Høil., **Puccinia** *violae* DC., **Pycnoporus** *cinnabarinus* (Jacq.) P.Karst., **Ramaria** *botrytis* (Pers.) Ricken, *R. fennica* var. *fumigata* (Peck) Schild, **Rhodocollybia** *butyracea* f. *asema* (Fr.) Antonín et al., *R. maculata* (Alb. et Schwein.) Singer, **Rickenella** *fibula* (Bull.) Raithelth., **Russula** *aeruginea* Lindbl., *R. albonigra* (Krombh.) Fr., *R. alutacea* (Pers.) Fr., *R. amoenolens* Romagn., *R. aurea* Pers., *R. chloroides* (Krombh.) Bres., *R. cyanoxantha* (Schaeff.) Fr., *R. farinipes* Romell, *R. fellea* (Fr.) Fr., *R. firmula* Jul. Schäff., *R. foetens* (Pers.) Fr., *R. galochroa* (Fr.) J.E.Lange, *R. heterophylla* (Fr.) Fr., *R. integra* (L.) Fr., *R. laurocerasi* Melzer, *R. lepida* Fr., *R. nigricans* (Bull.) Fr., *R. nobilis* Velen., *R. olivacea* (Schaeff.) Pers., *R. risigallina* (Batsch) Sacc., *R. undulata* Velen., *R. vesca* Fr., *R. violeipes* Quél., **Sarcodon** *imbricatus* (L.) P.Karst., **Schizophyllum** *commune* Fr., **Schizopora** *flavipora* (Berk. et M.A.Curtis ex Cooke) Ryvarden, *S. radula* (Pers.) Hallenb., **Scleroderma** *citrinum* Pers., **Simocybe** *centunculus* (Fr.) P.Karst., **Stereum** *gausapatum* (Fr.) Fr., *S. hirsutum* (Willd.) Gray, *S. rugosum* (Pers.) Fr., *S. sanguinolentum* (Alb. et Schwein.) Fr., **Stropharia** *aeruginosa* (Curtis) Quél., **Thelephora** *terrestris* Ehr., **Trametes** *gibbosa* (Pers.) Fr., *T. ochracea* (Pers.) Gilb. et Ryvarden, *T. velutina* (Planer) G.Cunn., *T. versicolor* (L.) Pilát, **Trechispora** *cohaerens* (Schwein.) Jülich et Stalpers, **Tremella** *foliacea* Pers., *T. mesenterica* Retz., **Trichaptum** *abietinum* (J.Dicks.) Ryvarden, *T. bifforme* (Fr.) Ryvarden, **Tricholoma** *acerbum* (Bull.) Vent., *T. album* (Schaeff.) P.Kumm., *T. flavobrunneum* (Fr.) Quél., *T. imbricatum* (Fr.) P.Kumm., *T. sejunctum* (Sowerby) Quél., *T. sulphureum* (Bull.) P.Kumm., *T. terreum* (Schaeff.) P.Kumm., *T. ustale* (Fr.) P.Kumm., *T. vaccinum* (Pers.) P.Kumm., *T. virgatum* (Fr.) P.Kumm., **Tricholomopsis** *rutilans* (Schaeff.) Singer, **Tubaria** *conspersa* (Pers.) Fayod, *T. romagnesiana* Arnolds, **Xerocomus** *chrysenteron* (Bull.) Quél., *X. ferrugineus* (Schaeff.) Bon, *X. subtomentosus* (L.) Quél., **Xerula** *melanotricha* Dörfelt, *X. pudens* (Pers.) Singer, *X. radicata* (Relhan) Dörfelt

Deuteromycota – Fungi imperfecti:

(6 species)

Bispora *antennata* (Pers.:Fr.) E.W. Mason, **Cylindrocarpon** *willkommii* (Lind.) Wollenw., **Cytospora** *ambiens* Sacc.,

Libertella faginea Desm., *Melasmia acerina* Lév.,
Tubercularia vulgaris (Tode: Fr.) Fr.

Cystofilobasidiales: (1 species)

Cryptococcus podzolicus (Babeva & Reshetova) Golubev

From this species spectrum we provide here short descriptions for some rarely or very rarely occurring and endangered species:

Ascomycota:

Cenococcum geophilum

An ectomycorrhizal species, growing in soil in mixed and coniferous forest stands. The presence of this species in the EES Kremnické vrchy Mts was only confirmed under *in vitro* conditions – using soil samples and sequencing analysis of clones cultivated from nrDNA templates (BUČINOVÁ, 2008; GRYNDLER et al., 2004).

Habrostictis rubra

Small reddish fruiting bodies of *H. rubra* grow very rarely in bark fissures on dying broadleaved woody plants. Perhaps due to their very small size, *H. rubra* fruiting bodies are often unnoticed. In Slovakia, this species was found only in the EES Kremnické vrchy Mts (ŠKUBLA, 2003).

Nectria peziza

A rare species, growing in decomposing wood of broadleaved and coniferous species. KEIZER (1998) reports its occurrence also in decomposing fruiting bodies of *Polyporus squamosus* (Huds.) Fr. In Slovakia, the species *N. peziza* has been reported from a single locality – Kopčany, Záhorie region (ŠKUBLA, 2003). Apart from the record of *N. peziza* at EES Kremnické vrchy Mts, the species was in year 2005 also registered in surroundings of the magnesite plant in Lubeník in the Revúcka vrchovina Mts (MIHÁL and BLANÁR, 2007), in 2001 in the locality National Nature Reserve Šarkanica in the National Park Muránska planina Plateau (leg. D. BLANÁR, det. I. MIHÁL, non-published), as well as in 2008 in the locality Zámčisko in the Chvojnická pahorkatina Hills and in the locality Michalková in the Javorie Mts (leg et det. I. MIHÁL, non-published).

Nectria purtonii

A species belonging to the family Nectriaceae. *N. purtonii* is a very rare species, parasiting on several fungi from the order Pyrenomycetales, eg *Diatrype disciformis* (Hoffm.) Fr., *D. stigma* (Hoff.) Fr., *Eutypella quaternata* (Pers.) Rappaz, *Valsa* sp. Apart from the Kremnické vrchy Mts, the occurrence of *N. purtonii* has only been confirmed in two geographical units of Slovakia (ŠKUBLA, 2003).

***Nectria radicicola* (anamorphs: *Cylindrocarpon destructans*)**

Fungus parasitizing on roots of broadleaved woody plants, occurring mostly in asexual form of *C. destructans*. In case of EES Kremnické vrchy Mts, the presence of this species was proved in conditions *in vitro* in soil samples, using the method of sequencing analysis of clones cultivated from nrDNA templates (BUČINOVÁ, 2008; GRYNDLER et al., 2004).

Pseudoplectania melaena

A very rare discomycetous species, growing in fir wood (VESELÝ et al., 1972). In Slovakia, this interesting species has been included among the threatened macrofungi (LIZOŇ, 1995). Occurrence of *P. melaena* has been, apart from the Kremnické vrchy Mts confirmed from four geographical units in Slovakia (ŠKUBLA, 2003). In the Czech Republic, the species belongs to the most severely endangered ones (ANTONÍN and BIEBEROVÁ, 1995).

Sphaerostibella aureonitens

A rare ascomycetous species, more known under the synonym of *Nectriopsis aureonitens* (Tul. et C.Tul) Maire. It grows as a sapro-parasite on aphyllorhous macrofungi. At the EES Kremnické vrchy Mts, the species was found growing on old fruiting bodies of *Stereum rugosum* (Pers.) Fr. In Slovakia, this species has hitherto been known from the EES Kremnické vrchy Mts, only (ŠKUBLA, 2003).

Basidiomycota:

Conocybe aporos

A saprophytic, humicolous species, rarely occurring in appropriate substrates in broadleaved forests. Due to its gracility and very small dimensions of fruiting bodies, the fungus is frequently unnoticed. Apart from the Kremnické vrchy Mts, the occurrence of *C. aporos* has been confirmed in five geographical units of Slovakia (ŠKUBLA, 2003).

Hymenogaster olivaceus

A rarely occurring mycorrhizal gasteromycetous fungus with fruiting bodies developing and growing partially immersed in soil. The occurrence of *H. olivaceus* has been, apart from the Kremnické vrchy Mts, confirmed only in two other geographical units of Slovakia (ŠKUBLA, 2003).

Mycena stipata

A saprophytic fungus, growing in clusters on dead and decomposing wood in broadleaved and mixed forests. The fungus is frequently confused with relative ones belonging to the range of *Mycena alcalina* agg. Occurrence of *M. stipata* has been, apart from the Kremnické vrchy Mts, confirmed only for two geographical units of Slovakia (ŠKUBLA, l.c.).

Phaeocollybia festiva

A rare species, occurring especially in coniferous forests, at higher altitudes. In Slovakia, the species belongs to the endangered macromycetes (LIZOŇ, 1995). Occurrence of *P. festiva* has been, apart from the Kremnické vrchy Mts, confirmed from four units of Slovakia (ŠKUBLA, l.c.).

Pseudotomentella tristis

A rarely occurring saprophytic species, belonging to the family of Thelephoraceae. It grows in moist forest soil, in decomposing plant debris or among stones. Apart from the Kremnické vrchy Mts, the occurrence of *P. tristis* has been confirmed from the Sitno Mountain in the Štiavnické vrchy Mts (ŠKUBLA, l.c.).

Russula amoenolens

An ectomycorrhizal symbiotic fungus, rarely growing in broadleaved forests. Apart from the Kremnické vrchy Mts, the occurrence of *R. amoenolens* has been reported from seven geographical units of Slovakia (ŠKUBLA, l.c.).

Trechispora cohaerens

A lignicolous fungus, forming resupinate fruiting bodies coloured cream to yellowish on dead branches, primarily in broadleaved woody plants. Together with several relative species of genus *Trechispora*, it is frequently unnoticed in nature. Apart from the Kremnické vrchy Mts, *T. cohaerens* has been recorded in the Bukovské vrchy Mts in eastern Slovakia (ŠKUBLA, l.c.).

Cystofilobasidiales:

Cryptococcus podzolicus

An interesting species, associated with forest soils in which it represents a very rich-in-species group of yeast fungi. It is necessary to note that some mycologists classify this species rather in the taxonomic group of yeasts (Endomycota), order Cystofilobasidiales or Trichosporonales (FELL et al., 2000; SCORZETTI et al., 2002). Other authors consider the species *C. podzolicus* relative to the taxonomic order of Tremellales (Basidiomycota), and describe it here as a species manifesting mitosporic yeast phase within its development (UNIPROT CONSORTIUM, 2008; RHODE, 2005). For the EES Kremnické vrchy Mts, the occurrence of this species was proved in conditions *in vitro* from soil samples, by using sequencing analysis of clones obtained from nrDNA templates (BUČINOVÁ, 2008; GRYNDLER et al., 2004).

Among macromycetes with rare or very rare occurrence in Slovakia we can also include: *Helvella lacunosa*, *Hymenoscyphus fagineus*, *Orbilina luteorubella*, *Cortinarius venetus* var. *montanus*, *Chrysomphalina chrysophyllum*, *Hericium coralloides*, *Lentaria mucida*, *Pluteus salicinus*, *Sarcodon imbricatus*, *Tricholoma virgatum*, *Xerula pudens* and others

From macromycetes characteristic for thermophilous or Pannonian flora, we report here: *Amanita vaginata*, *Basidioradulum radula*, *Boletus regius*, *B. subapplendiculatus*, *Entoloma sinuatum*, *Hirneola auricula-judae*, *Marasmiellus foetidus*, *Phallus impudicus*, *Polyporus arcularius*, *Russula aurea*, *Scleroderma citrinum*, *Tricholoma acerbum*, and *Xerocomus subtomentosus*. Analogically, we can document the species having its occurrence optimum in highly situated fir-beech, fir and spruce vegetation zones: *Armillaria ostoyae*, *Climacocystis borealis*, *Dacrymyces stillatus*, *Fomitopsis pinicola*, *Gloeophyllum abietinum*, *Heterobasidion annosum*, *Lepista flaccida*, *Mycena rosea*, *Oligoporus subcaesius*, *Omphalina epichysium*, *Pholiota flammans*, *Pseudohydnum gelatinosum*, *Rickenella fibula*, *Trichaptum abietinum*, and others. In case of these species, it is necessary to note that the presence of fir trees in the locality substituted, to a certain extent, ecotopic and ecotrophic conditions characteristic for fir and spruce stand situated at higher altitudes. In spite of a low percent share of fir in the forest stand at the EES Kremnické vrchy Mts, there occurred rather high numbers of macromycetes closely associated with fir or with by-fir-created environment.

Abundance of macromycetes classified to the individual eco-trophic groups is illustrated in Table 2. We can see that markedly dominant were saprophytic species (LS – 127 and TS – 102 species), and lower dominant mycorrhizal species (MS – 97 species), and we can conclude that the studied mycocoenosis in the beech stand at the EES Kremnické vrchy Mts has a conspicuous symbiotic-saprophytic character. At the same time, we also recorded several parasitic species (phyto-, myco-, and lingo-parasites), having in the given ecosystem an important role, mainly in terms of their influence on health state of forest woody plants (Table 3). The most important lignicolous parasites are, for example the species: *Armillaria ostoyae*, *Fomes fomentarius*, *Fomitopsis pinicola*, *Heterobasidion annosum*, *Kretzschmaria deusta*, species of the genus *Nectria*, *Pholiota adiposa*, *Phellinus hartigii*, and others. In the saprophytic species *Armillaria ostoyae* growing at the EES Kremnické vrchy Mts, we monitored dynamics of abundance and biomass production in its fruiting bodies (MIHÁL, 1995, 1996b). As parasitic ones were also recorded several species parasitizing on leaves of herbs and woody plants, eg *Coleosporium tussilaginis*, *Puccinia violae*, *Rhytisma acerinum*, and others. From the fungi parasitizing on other fungi we recorded several species belonging to the genera *Hypomyces* and *Nectria*, and the species *Sphaerostibella aureonitens*.

Apart from determination of species diversity of macromycetes in beech stands at the EES Kremnické vrchy Mts, we also conducted research on abundance and distribution of their fruiting bodies. Providing with the results of evaluation of dynamics of the species dominance, we also assessed succession dynamics of the

macromycetes, and quantified biomass production in fruiting bodies of selected macromycetes species (MIHÁL, 1993, 1995, 1996b, 1998; MIHÁL and BUČINOVÁ, 2005, 2007). We do not consider our mycofloristic and mycocoenological research in beech stands at the EES Kremnické vrchy Mts as complete. For obtaining results relevant for describing appropriately the succession dynamics of the mycocoenosis at the EES Kremnické vrchy Mts, long-term monitoring of the mycoflora is, according to our opinion, inevitable.

Table 2. Number of species within individual ecotrophic groups

Ecotrophic groups							Total
LP	HP	MP	LS	TS	MS	E	
14	6	6	127	102	97	1	353

LP, lignicolous parasites; HP, herbivorous parasites; MP, mycoparasites; LS, lignicolous saprophytes; TS, terrestrial saprophytes; MS, mycorrhizal symbionts; E, epiphytes

Table 3. Enumeration of fungal parasites

Species	LP	HP	MP
<i>Armillaria ostoyae</i>	×		
<i>Coleosporium tussilaginis</i>		×	
<i>Cylindrocarpon willkommii</i>	×		
<i>Fomes fomentarius</i>	×		
<i>Fomitopsis pinicola</i>	×		
<i>Ganoderma lipsiense</i>	×		
<i>Heterobasidion annosum</i>	×		
<i>Hypomyces chrysospermus</i>			×
<i>Hypomyces luteovirens</i>			×
<i>Inonotus nodulosus</i>	×		
<i>Kretzschmaria deusta</i>	×		
<i>Melasmia acerina</i>		×	
<i>Microsphaera alphitoides</i>		×	
<i>Nectria cosmariospora</i>			×
<i>Nectria ditissima</i>	×		
<i>Nectria episphaeria</i>			×
<i>Nectria galligena</i>	×		
<i>Nectria purtonii</i>			×
<i>Nectria radicularia</i>	×		
<i>Phellinus hartigii</i>	×		
<i>Pholiota adiposa</i>	×		
<i>Phragmidium rubi-idaei</i>		×	
<i>Pleurotus ostreatus</i>	×		
<i>Puccinia violae</i>		×	
<i>Rhytisma acerinum</i>		×	
<i>Sphaerostibella aureonitens</i>			×
Total	14	6	6

LP, HP, MP – see Table 2

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Mykoflóra bukových lesov Kremnických vrchov (stredné Slovensko)

Súhrn

Počas rokov 1990 až 2008 sme skúmali mykoflóru bukových lesných porastov na Experimentálnom a ekologickom stacionári (EES) v južnej časti Kremnických vrchov. Počas doby výskumu sme v poraste EES determinovali celkovo 353 druhov húb. Medzi vzácné sa vyskytujúce a ohrozené huby zistené v poraste EES môžeme zaradiť napr. druhy: *Coenococcum geophilum*, *Habrostictis rubra*, *Nectria punicea*, *Sphaerostibella aureonitens* (Ascomycota), *Hymenogaster olivaceus*, *Mycena stipata*, *Phaeocollybia festiva*, *Pseudotomentella tristis* (Basidiomycota) a *Cryptococcus podzolicus* (Cystofilobazidiales). V bukovom poraste EES sa vyskytovali druhy typické pre podmienky teplomilnej, panónskej flóry a zároveň sa tu vyskytovali aj druhy charakteristické pre horské jedľobučiny a smrečiny. Z rozdelenia početnosti druhov do jednotlivých ekotrofických skupín vidno výrazný symbioticko-saprofytický charakter mykocenózy lesného porastu EES. Z celkovej druhovej diverzity makromycétov sa pomerne málo druhov vyskytovalo paraziticky. Z mykofloristického hľadiska je potrebné územiu Kremnických vrchov venovať v budúcnosti viac pozornosti.

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