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Species diversity, abundance and dominance of macromycetes in beech forest stands

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ABSTRACT: The aim of this paper is to contribute to the knowledge of dynamics of species diversity, abundance, distribution of fruiting bodies and dominance of macromycetes in mycocoenosis of beech monocultures. The problems were studied in beech monocultures on three permanent research plots with various impacts of air pollutants generated by the aluminium plant in Žiar nad Hronom. Over the research period we determined 121 macromycete species and one species of imperfect fungus. We found relatively balanced values of abundance, fruiting body distribution and species dominance on all the examined plots. The species diversity in groups consisting of the most dominant species was practically the same on each plot. As for the ecotrophic requirements of individual macromycetes, we can conclude that the diversity of tree parasites decreased with decreasing pollutant load. We also found out relatively balanced numbers of lignicolous saprophytes and terrestrial saprophytes on each research plot. Air pollutants also influenced the species spectrum of ectomycorrhizal macromycetes negatively (only 6 species on the plot with highest pollution stress and 21 species on the plot with lowest pollution stress).

Keywords: *Fagus sylvatica* L.; macromycetes; species diversity; abundance; dominance

The proportion of beech stands in Slovakian forests was 30.28% in 2000 (Kolektív 2001). The significance of these beech stands for landscape ecology and forest management is out of question. Until recently biotic damage to beech trees – endangered by insects and fungi – was considered to be of small importance only (Korpeľ et al. 1991). However, in the last years a steep increase in biotic damage to beech has been evident, both in connection with increasing populations of leaf-eating and wood-boring insects and in connection with increasing occurrence of fungal diseases – mycoses. Very important are fungal diseases that are frequently chronic and that can be local or have a character of widespread epiphytoty.

Macromycetes growing in beech stands constitute a complex ecotrophic and ecotopic system, connected with the beech and associated environment. Consequently, the study of the relations between macromycetes – beech – environment is not simple but inevitable for understanding the role played by the mycoflora in beech stands. Apart from other characteristics every mycocoenosis in beech stands is specified by the species diversity, dominance and abundance, distribution and production of fruiting bodies.

Mycoflora and especially mycocoenoses in beech stands were studied by several authors. For example, species diversity, dominance and succession in the macromycetes were studied in Slovakia by Vaník (1970), Mihál (1994, 1995a, 2002) and Pavlík (1997), abroad by Holec (1994), Adamczyk (1995), Andersson (1995), Tratnik and Pohleven (1995), Willig and Schlechte (1995). Abundance and distribution conditions and fruiting body production of macromycetes in beech stands were studied in Slovakia by Mihál (1995b, 1998), abroad by Matsuda (1994), Sarerni and Perini (2004) and others.

The aim of this paper is to contribute to the knowledge of dynamics of species diversity, abundance, distribution of fruiting bodies and dominance of

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Table 1. Characteristics of the research plots

Characteristics	RMP Žiar nad Hronom	PRP Jalná	EES Kováčová
Orographic unit	Štiavnické vrchy Mts.	Štiavnické vrchy Mts.	Kremnické vrchy Mts.
Code of DFS	7479a	7479b	7380
Area (ha)	0.15	0.25	0.15
Exposition	NW	W	W
Altitude (m)	470	610	470–490
Stand age (years)	75–80	80–90	95–100
Stocking	0.7	0.8–0.9	0.8–0.9
Parent rock	rhyolite tuffites	andesite, tuffites	andesite, tuffites
Soil type	cambisol luvisol	cambisol	cambisol
Forest type groups	*Fagetum pauper*	*Querceto-Fagetum*	*Fagetum pauper*
Average annual temperature (°C)	7.6	6.2	6.8
Average annual precipitation (mm)	750	850	778
Distance from emission source (km)	2	7	18
Wet deposition* (in 1994) (kg/ha)			
SO_4^{2-}	26.3	not determined	18.1
F^-	2.5	not determined	0.4

RMP – Research monitoring plot Žiar nad Hronom, PRP – Permanent research plot Jalná, EES – Ecological and experimental station Kováčová, Code of DFS – mapping grid of the Database of Fauna of Slovakia
*Results of wet deposition taken from Dubová and Bublinec (1994)

macromycetes in the mycocoenosis of beech unmixed monocultures.

MATERIAL AND METHODS

The problems were studied on three permanent research plots in unmixed beech stands with different impacts of air pollutants generated by the aluminium plant in Žiar nad Hronom. The particular characteristics of research plots are given in Table 1.

Research was conducted in the vegetation periods 2003 and 2004. The observations were made once monthly, on the following dates in 2003: 28. 5., 11. 6., 15. 7., 5. 8., 10. 9., 1. 10., 11. 11. and in 2004: 19. 5., 16. 6., 13. 7., 10. 8., 23. 9., 13. 10., 8. 11.

At the field excursions we recorded species diversity and fruiting body abundance of the macromycetes on the plots. Apart from this, we also recorded the fruit body distribution – that means the number of sites on the respective plot with the occurrence of macromycete fruiting bodies. We obtained abundance number **A** (number of fruiting bodies) and distribution number **D** (number of sites with fruiting bodies occurrence) for each examined species in this way. The sum of the characteristics **A + D** was the dominance number (**Do**), classifying the species to the corresponding category of dominant species in the mycocoenosis on the plot. More details about the method can be found in Mihál (1994, 1995b). It is necessary to note that in the case of fruticose and resupinate fruiting bodies of lignicolous species the value of the species abundance was equal to the value of the species distribution in most cases because it was not possible to obtain precise numbers of fruiting bodies for these species (e.g. *Bisporella citrina, Calocera viscosa, Durela commutata, Hypoxylon multiforme, Trametes versicolor*, etc.).

The species were determined according to Červenka et al. (1971), Veselý et al. (1972), Moser (1967), Jülich (1984), Breitenbach and Kränzlin (1986), Hagara et al. (1999) and others. We also performed comparisons with the reference material collected by the first author of this paper. Selected species of the determined macromycetes are deposited as exsiccated items by the first author in the Institute of Forest Ecology of Slovak Academy of Sciences in Zvolen.

On the research plots we recorded species belonging to Ascomycotina and Basidiomycotina. Species belonging to Fungi imperfecti – Deuteromycetes were not (except for *Bispora antennata*) recorded due to high demands on their laboratory cultivation and determination.

All the determined macromycete species were classified according to their ecotrophic demands (i.e. substrate on which they were grown) to the following ecotrophic groups: lignicolous found on woody substrate (parasitic and saprophytic fungi), terrestrial

growing on humus litter and soil horizons (saprophytic and ectomycorrhizal fungi), myco-parasitic and epiphytic fungi.

RESULTS AND DISCUSSION

The following list presents the determined macromycetes together with an abbreviation of the research plot on which the fungus was found. We classified the species to Ascomycotina, Basidiomycotina and one species to Deuteromycotina – Fungi imperfecti. Taxonomic nomenclature according to Marhold and Hindák (1998) and Škubla (2003) was used.

Macromycetes determined on the Research Monitoring Plot (R) Žiar nad Hronom, Permanent Research Plot (P) Jalná and Ecological and Experimental Site (E) Kováčová:

Ascomycotina: 1. *Ascodichaena rugosa* (L.) Butin, E,P,R, 2. *Bisporella citrina* (Batsch) Korf. et S.E.Karp. P,R, 3. *Chlorociboria aeruginascens* (Nyl.) Kanouse ex Ramamurthi et al. P, 4. *Diatrype disciformis* (Hoffm.) Fr. E,P,R, 5. *Durella commutata* Fuckel, P,R, 6. *Hypoxylon cohaerens* (Pers.) Fr. P, 7. *H. fragiforme* (Pers.) J.Kickx f. E,P,R, 8. *H. multiforme* (Fr.) Fr. E,P,R, 9. *Kretzschmaria deusta* (Hoffm.) P.M.D.Martin, E,P,R, 10. *Lachnum virgineum* (Batsch) P.Karst. P, 11. *Melanopsamma pomiformis* (Pers.) Sacc. E,P,R, 12. *Nectria cinnabarina* (Tode) Fr. E,P,R, 13. *N. coccinea* (Pers.) Fr. P,R, 14. *N. cosmariospora* Ces. et de Not. P, 15. *N. galligena* Bres. ex Strasser P,R, 16. *Peziza arvernensis* Boud. E,P, 17. *Pseudovalsa spinifera* (Wallr.) E.M.Barr. E,P,R, 18. *Valsa ambiens* (Pers.) Fr. E,P,R, 19. *Xylaria hypoxylon* (L.) Grev. R, 20. *X. polymorpha* (Pers.) Grev. R.

Basidiomycotina: 1. *Agrocybe praecox* (Pers.) Fayod E,R, 2. *Amanita vaginata* (Bull.) Lam. R, 3. *Auricularia mesenterica* (Dicks.) Pers. P, 4. *Bjerkandera adusta* (Willd.) P.Karst. P,R, 5. *Calocera viscosa* (Pers.) Fr. E, 6. *Cantharellus cibarius* Fr. E, 7. *C. pallens* Pilát E, 8. *C. tubaeformis* Fr. E, 9. *Chondrostereum purpureum* (Pers.) Pouzar E,P,R, 10. *Clitocybe brumalis* (Fr.) P.Kumm. R, 11. *C. metachroa* (Fr.) P.Kumm. R, 12. *C. nebularis* (Batsch.) P.Kumm. E,P, 13. *C. odora* (Bull.) P.Kumm. E, 14. *Coprinus micaceus* (Bull.) Fr. E,P,R, 15. *Cortinarius* sp. E, 16. *Craterellus cornucopioides* (L.) Pers. E, 17. *Cyathus striatus* (Huds.) Willd. P,R, 18. *Dacrymyces stillatus* Nees P, 19. *Daedalea quercina* (L.) Fr. P, 20. *Daedaleopsis confragosa* (Bolton) J.Schröt. P,R, 21. *Entoloma rhodopolium* f. *nidorosum* (Fr.) Noordel. E, 22. *Exidia glandulosa* (Bull.) Fr. E,P,R, 23. *Fomes fomentarius* (L.) J.Kickx f. P,R, 24. *Gymnopilus penetrans* (Fr.) Murrill E,P,R, 25. *Gymnopus erythropus* (Pers.) Antonín et al. E,R, 26. *G. peronatus* (Bolton) Antonín et al. E, 27. *Hebeloma crustuliniforme* (Bull.) Quél. P, 28. *Hirneola auricula-judae* (Bull.) Berk. R, 29. *Hygrophorus eburneus* (Bull.) Fr. E,P,R, 30. *Hymenochaete rubiginosa* (J.Dicks.) Lév. E,P, 31. *Hypholoma fasciculare* (Huds.) P.Kumm. P,R, 32. *Inocybe rimosa* (Bull.) P.Kumm. E, 33. *Inonotus cuticularis* (Bull.) P.Karst. P, 34. *I. nodulosus* (Fr.) P.Karst. P, 35. *Laccaria amethystina* (Huds.) Cooke E,P,R, 36. *L. laccata* agg. E, 37. *Lactarius blennius* (Fr.) Fr. R, 38. *L. chrysorrheus* Fr. E, 39. *L. piperatus* (L.) Gray E,P,R, 40. *Laeticorticium roseum* (Pers.) Donk R, 41. *Laetiporus sulphureus* (Bull.) Murrill P, 42. *Lycoperdon lividum* Pers. R, 43. *L. perlatum* Pers. E,P,R, 44. *L. pyriforme* Schaeff. E, 45. *Marasmius alliaceus* (Jacq.) Fr. E,P, 46. *M. rotula* (Scop.) Fr. R, 47. *Megacollybia platyphylla* (Pers.) Kotl. et Pouzar E,P, 48. *Mycena alcalina* agg. E,P,R, 49. *M. citrinomarginata* Gillet E,P, 50. *M. galericulata* (Scop.) Gray E,P, 51. *M. galopus* (Pers.) P.Kumm. P, 52. *M. haematopus* (Pers.) P.Kumm. E,P,R, 53. *M. pura* (Pers.) P.Kumm. E,P,R, 54. *M. polygramma* (Bull.) Gray E,P, 55. *M. renati* Quél. E,P, 56. *M. rosella* (Fr.) P.Kumm. E,P, 57. *Oligoporus stipticus* (Pers.) Gilb. et Ryvarden R, 58. *O. tephroleucus* (Fr.) Gilb. et Ryvarden P, 59. *Panellus stipticus* (Bull.) P.Karst. R, 60. *Phlebia tremellosa* (Schrad.) Nakasone et Burds. R, 61. *Pholiota adiposa* (Batsch) P.Kumm. E, 62. *P. squarrosa* (Weigel) P.Kumm. P, 63. *Pleurotus ostreatus* (Jacq.) P.Kumm. P, 64. *P. pulmonarius* (Fr.)

Table 2. Abundance, distribution and dominance of macromycetes on research plots

Plots	*N*	2003			2004			2003 + 2004		
		A	D	Do	A	D	Do	A	D	Do
RMP	61	1,036	500	1,536	1,613	690	2,303	2,649	1,190	3,839
PRP	78	1,053	570	1,623	1,056	716	1,772	2,109	1,286	3,395
EES	68	618	495	1,113	1,815	584	2,399	2,433	1,079	3,512
Total	122	2,707	1,565	4,271	4,484	1,990	6,474	7,191	3,555	10,746

A – abundance of fruit bodies, D – distribution of fruit bodies, Do (A + D) – number of dominance, *N* – number of determined species of macromycetes

Quél. E, 65. *Plicaturopsis crispa* (Pers.) D.A.Reid R, 66. *Pluteus cervinus* (Schaeff.) P.Kumm. E,P,R, 67. *P. salicinus* (Pers.) P.Kumm. E,R, 68. *Psathyrella piluliformis* (Bull.) P.D.Orton P,R, 69. *P. spadiceogrisea* (Schaeff.) Maire E,P, 70. *Psilocybe inquilina var. crobula* (Fr.) Høil. R, 71. *Polyporus brumalis* (Pers.) Fr. P, 72. *P. melanopus* (Sw.) Fr. E,P, 73. *P. varius* (Pers.) Fr. E,P,R, 74. *Rhodocollybia butyracea f. asema* (Fr.) Antonín et al. E,P,R, 75. *R. maculata* (Alb. et Schwein.) Singer R, 76. *Russula amoenolens* Romagn. E, 77. *R. aurea* Pers. E, 78. *R. cyanoxantha* (Schaeff.) Fr. E,P, 79. *R. fellea* (Fr) Fr. P, 80. *R. firmula* Jul. Schaeff. P, 81. *R. foetens* (Pers.) Fr. E, 82. *R. galochroa* (Fr.) J.E.Lange E, 83. *R. heterophylla* (Fr.) Fr. P, 84. *R. virescens* (Schaeff.) Fr. P, 85. *Schizophyllum commune* Fr. P,R, 86. *Scleroderma citrinum* Pers. P, 87. *Stereum gausapatum* (Fr.) Fr. R, 88. *S. hirsutum* (Willd.:Fr.) Gray E,P,R, 89. *S. rugosum* (Pers.) Fr. E,P,R, 90. *Strobilomyces strobilaceus* (Scop.) Berk. P, 91. *Stropharia aeruginosa* (Curtis) Quél. E,P, 92. *Trametes gibbosa* (Pers.) Fr. R, 93. *T. hirsuta* (Wulfen) Pilát P, 94. *T. versicolor* (L.) Pilát E,P,R, 95. *Tremella foliacea* Pers. E, 96. *Tricholoma sulphureum* (Bull.) P.Kumm. E., 97. *Tubaria conspersa* (Pers.) Fayod E,R, 98. *Xerocomus chrysenteron* (Bull.) Quél. E,P,R, 99. *Xerula melanotricha* Dörfelt E, 100. *X. radicata* (Relhan) Dörfelt E,P,R, 101. *Xylobolus frustulatus* (Pers.) Boidin P.

Deuteromycotina – Fungi imperfecti: 1. *Bispora antennata* (Pers.: Fr.) E.W. Mason E,P.

The total number of the fungal species determined over the research period was 121 macromycetes and one imperfect fungus. The numbers of the species determined on the individual plots, together with the values of abundance, distribution and dominance of the macromycetes are summarised in Table 2.

In Table 2 we can see quite equilibrated dynamics of abundance and distribution of macromycete fruiting bodies over all the examined plots. It is necessary to add that these values reflect the overall status of mycocoenoses on the plots. If the microclimatic conditions on the plots were more favourable, we should have observed higher species diversity of the macromycetes and also higher values of the abundance and distribution of fruiting bodies. Unfavourable microclimatic conditions and poor species composition of beech monocultures can be considered as the main factors adversely influencing mycocoenoses in forest stands of the kind. For example, in dry years 1992 and 1993 in the stand on the PRP Jalná 83 macromycetes species were determined that produced 817 fruiting bodies (Mihál 1995b). In Table 2 we can see that the values recorded in 2004 were higher on all plots compared to the year 2003. Summarising the values from both years we obtained quite equilibrated values of abundance, distribution and dominance on all the plots. These values reflect more or less equal microclimatic, ecological and ecotrophic conditions on all plots – which is also evident from the plot description in Table 1.

In Table 3 we present the species composition of macromycetes with the highest dominance on the plots. It is necessary to note that due to the lack of space we can present only the first quarter of the most dominant species out of the total species number on each plot. We can conclude that the groups of the highest dominant species consist of almost the same species on each plot (*Ascodichaena rugosa, Diatrype disciformis, Hypoxylon fragiforme, Valsa ambiens, Pseudovalsa spinifera, Polyporus varius, Stereum hirsutum*). These species occurred most frequently and reached high values of both

Table 3. The most dominant species of macromycetes on research plots

Plots	Species of macromycetes	Do total
RMP	*Marasmius rotula* (775), *Hypoxylon fragiforme* (460), *Cyathus striatus* (313), *Valsa ambiens* (274), *Coprinus micaceus* (258), *Stereum hirsutum* (202), *Rhodocollybia butyracea* f. *asema* (191), *Diatrype disciformis* (141), *Polyporus varius* (135), *Gymnopus erythropus* (116), *Pseudovalsa spinifera* (98), *Clitocybe brumalis* (92), *Ascodichaena rugosa* (84), *Panellus stipticus* (83), *Psathyrella piluliformis* (77)	3,299
PRP	*Hypoxylon fragiforme* (488), *Mycena renati* (460), *Valsa ambiens* (360), *Stereum hirsutum* (286), *Ascodichaena rugosa* (244), *Diatrype disciformis* (198), *Polyporus varius* (169), *Mycena galericulata* (156), *Inonotus nodulosus* (138), *Mycena rosella* (110), *Mycena citrinomarginata* (83), *Pseudovalsa spinifera* (68), *Exidia glandulosa* (48), *Pluteus cervinus* (46), *Mycena pura* (44), *Bispora antennata* (42), *Strobilomyces strobilaceus* (41), *Xerula radicata* (40), *Mycena alcalina* (37)	3,058
EES	*Lycoperdon pyriforme* (542), *Cantharellus tubaeformis* (530), *Valsa ambiens* (348), *Ascodichaena rugosa* (328), *Hypoxylon fragiforme* (324), *Craterellus cornucopioides* (233), *Stereum hirsutum* (182), *Diatrype disciformis* (166), *Marasmius alliaceus* (124), *Polyporus varius* (123), *Lactarius piperatus* (90), *Hymenochaete rubiginosa* (88), *Hygrophorus eburneus* (79), *Hypoxylon fragiforme* (66), *Pseudovalsa spinifera* (60), *Kretzschmaria deusta* (44), *Mycena alcalina* (31)	3,358

Do – number of dominance (in the parenthesis), RMP – 15 species of macromycetes (the 1st quarter of the most dominant species on RMP plot), PRP – 19 species of macromycetes, EES – 17 species of macromycetes

Table 4. Number of macromycete species in the ecotrophic groups

Plots	Lignicolous species		Terrestrial species		Epiphyte	Mycoparasite
	parasite	saprophyte	saprophyte	ectomycorrhizal		
RMP	6	34	13	6	1	–
PRP	8	39	16	14	1	1
EES	2	29	17	21	1	–
Total	10	58	46	41	1	1
Total	68		87		1	1

Epiphyte: *Ascodichaena rugosa*, Mycoparasite: *Nectria cosmariospora*

Because the species numbers in the ecotrophic groups were considerable, we do not present the enumeration of lignicolous and terrestrial species here (except for the two mentioned species). All the species are listed in the survey of the determined macromycetes at the beginning of the Results and Discussion section

abundance and distribution of fruiting bodies. Naturally, the groups of the most dominant species also contained species typical of the given plot only, e.g. on the RMP we recorded *Marasmius rotula, Cyathus striatus* and others, on PRP *Mycena renati, Mycena galericulata* and others and at the EES *Lycoperdon pyriforme, Cantharellus tubaeformis* and others.

Several of the most dominant macromycete species presented in Table 3 were found in beech stands also by other authors. Tratnik and Pohleven (1995) reported *Hypoxylon fragiforme* as a fungus frequently occurring on dead wood in beech stands. According to Andersson (1995), the most frequent species in beech stands is *Xylaria hypoxylon*, and other characteristic species are *Hypoxylon fragiforme, Kretzschmaria deusta, Polyporus varius, Pseudovalsa spinifera* and *Stereum hirsutum*. Vaník (1970) also classified the species *Diatrype disciformis, Fomes fomentarius, Hypoxylon fragiforme, Kretzschmaria deusta*, *Stereum hirsutum, Trametes versicolor* as macromycetes typical of beech stands. According to Willig and Schlechte (1995) *Schizophyllum commune, Trametes hirsuta* and *Trametes versicolor* were the species with the highest abundance and occurrence frequency on dead beech wood. In addition to the above listed species Adamczyk (1995) classified the following fungi as the most dominant in beech stands: *Marasmius alliaceus*, *Marasmius rotula, Mycena galericulata* and *Rhodocollybia butyracea* f. *asema*.

Apart from the characteristics presented in Tables 2 and 3, the beech stand mycocoenoses on the research plots can also be characterised by means of ecotrophic demands of the macromycetes (Table 4). The species diversity of macromycetes in Table 4 was classified in two basic ecotrophic groups with four subgroups. Chasseur (1992), who studied enzymatic activities in saprophytic fungi, worked with a higher number (eight) of ecotrophic groups.

As it is evident in Table 4, the diversity of lignicolous parasites was the highest on the PRP Jalná, followed by the RMP Žiar nad Hronom, and it was the lowest at the EES Kováčová. To a certain extent, this can be caused by the air pollutant load that is the most severe on the RMP. It is well known that the occurrence of parasitic fungi increases in pollution-loaded forest stands (Jupina 1987). It follows from our observations that this phenomenon is present not only in aphilophoral and agaric parasites but also in macromycetes causing necrotic diseases of tracheomycotic type, which is primarily the case of fungi of the *Nectria* (Fr.) Fr. genus. All parasitic fungi determined on the research plots are listed in Table 5. We can see that the occurrence of *Nectria* fungi was massive on two plots and caused the epiphytoty of beech bark necrotic diseases on the stems. The epiphytoty entailed high beech mortality, primarily

Table 5. Parasitic macromycetes determined on research plots

Plots	Species of macromycetes
RMP	*Kretzschmaria deusta* (28), *Fomes fomentarius* (14), *Stereum rugosum* (12), *Daedaleopsis confragosa* (3), *Nectria coccinea* (epiphytosis), *Nectria galligena* (epiphytosis)
PRP	*Inonotus nodulosus* (138), *Kretzschmaria deusta* (30), *Stereum rugosum* (12), *Fomes fomentarius* (12), *Inonotus cuticularis* (2), *Pholiota squarrosa* (2), *Nectria coccine* (epiphytosis), *Nectria galligena* (epiphytosis)
EES	*Kretzschmaria deusta* (30), *Pholiota adiposa* (2)

Do – number of dominance (in the parenthesis)

on the plot RMP Žiar nad Hronom. Cicák and Mihál (2002) reported that the proportions of beech trees manifesting the highest degrees of necrotic damage were: 31.9% on RMP, 24.6% on PRP and only 1.6% at the EES.

Air pollutants also influenced the species spectrum of ectomycorrhizal macromycetes negatively (only 6 species on RMP and 21 species at the EES – Table 4). This negative impact was confirmed by Pavlík (1997), who compared the species diversity of fungi on the RMP Žiar nad Hronom loaded with air pollutants and on a control (relatively clean) plot. Pavlík (l.c.) found a drop in ectomycorrhizal macromycetes on RMP with a simultaneous increase in the number of saprophytic macromycete species.

We can see in Table 4 that there were quite equilibrated numbers of lignicolous saprophytes and terrestrial saprophytes on each monitoring plot. For the lignicolous saprophytes the appropriate amount of dead wood substrate is a factor limiting their occurrence. The stands on RMP Žiar nad Hronom and PRP Jalná have sufficient amounts of wood substrate that has been colonised by lignicolous saprophytic macromycetes. Vaník (1970) considered lignicolous fungi in beech stands as useful saprophytes supporting the forest "self-cleaning" function by removing dry branches from beech stems and decomposing the stumps. However, the same species can turn to noxious parasites under circumstances when the stand is weakened by long dry periods or other harmful factors (insects, mechanical damage).

In the case of terrestrial saprophytes, in addition to climatic conditions, the soil humification process and thickness of humus and litter layers are limiting factors. According to Holec (1994) the litter thickness and the humus form influence the numbers of saprophytic and ectomycorrhizal fungi and their ratio. For example, in beech stands with prevailing mull humus form more saprophytic than ectomycorrhizal macromycetes occur. Murphy and Miller (1993) found that the saprophytic fungus *Collybia subnuda* was also one of the dominant species in deciduous forests. Similarly, Tyler (1991) studied the influence of litter removal on macromycetes production. On the plots with litter this author found higher production of fruiting bodies of the saprophytic species *Mycena cinerella, Mycena galopoda* and *Rhodocollybia butyracea* f. *asema*; on the plots from which the litter had been removed the production of *Lactarius* and *Russula* was highest. On the contrary, Sarerni and Perini (2004) studying production dynamics of fruiting bodies of the ectomycorrhizal species *Boletus edulis* found the highest production of fruiting bodies on plots with sufficiently thick litter layer.

CONCLUSIONS

In 2003 and 2004 we studied macromycete species diversity, abundance and distribution of fruiting bodies and species dominance in mycocoenoses in three beech monocultures with different load of air pollutants. Over the research period we determined in total 121 macromycete species and one species of imperfect fungus on the research plots. We found relatively balanced values of abundance, fruiting body distribution and species dominance on all the examined plots. The species diversity in groups consisting of the most dominant species was practically the same on each plot. In addition, on each plot there also occurred species specific to the given environment only. The most dominant species were: *Ascodichaena rugosa, Diatrype disciformis, Hypoxylon fragiforme, Valsa ambiens, Pseudovalsa spinifera, Polyporus varius, Stereum hirsutum*. On the examined plots these species were the most frequent and reached high abundance and distribution of fruiting bodies. As for the ecotrophic requirements of individual macromycetes, we can conclude that the diversity of lignicolous parasites decreased from the RMP Žiar nad Hronom to the EES Kováčová. This trend can follow from the air pollutant load to a certain extent that is highest on the RMP Žiar nad Hronom. All the parasitic species determined on the research plots are listed in Table 5. Examining Table 5 we can see that on two plots there was massive occurrence of fungi of the *Nectria* genus causing the epiphytoty of beech bark disease on tree stems. The epiphytoty entailed a high mortality of beech trees, primarily on the plot Žiar nad Hronom. We also found relatively balanced numbers of lignicolous saprophytes and terrestrial saprophytes on each research plot. The air pollutant stress also influenced the species spectrum of ectomycorrhizal macromycetes negatively (only 6 species on RMP and 21 species at EES – Table 4).

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Druhová diverzita, abundancia a dominancia makromycétov v bukových lesných porastoch

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ABSTRAKT: Cieľom práce je prispieť k poznaniu dynamiky druhovej diverzity, abundancie, distribúcie plodníc a dominancie makromycétov v mykocenóze nezmiešaných bukových lesných porastov. Problematiku sme skúmali na troch

trvalých výskumných plochách v porastoch nezmiešanej bučiny, ktoré sú pod rozdielnym vplyvom imisnej záťaže z emisného zdroja – hliníkárne v Žiari nad Hronom. Celkovo sme počas doby výskumu zistili 121 druhov makromycétov a jeden druh nedokonalej huby. Zistili sme pomerne vyrovnané hodnoty abundancie, distribúcie plodníc a dominancie druhov na všetkých troch výskumných plochách. Druhová diverzita v skupine najdominantnejších druhov bola na každej ploche skoro zhodná. Z hľadiska ekotrofických nárokov makromycétov možno konštatovať, že u lignikolných parazitov badať pokles diverzity od najviac imisne zaťaženej plochy po plochu imisne najmenej zaťaženú. Zistili sme pomerne vyrovnaný počet lignikolných saprofytov a terestrických saprofytov na každej výskumnej ploche. Negatívny vplyv imisií sa odráža aj na druhovom spektre ektomykoríznych makromycétov (iba šesť druhov na imisne najviac zaťaženej ploche a 21 druhov na imisne najmenej zaťaženej ploche).

Kľúčové slová: *Fagus sylvatica* L.; makromycéty; druhová diverzita; abundancia; dominancia

Cieľom práce je prispieť k poznaniu dynamiky druhovej diverzity, abundancie, distribúcie plodníc a dominancie makromycétov v mykocenóze nezmiešaných bukových lesných porastov.

Problematiku sme skúmali na troch trvalých výskumných plochách v porastoch nezmiešanej bučiny, ktoré sú pod rozdielnym vplyvom imisnej záťaže z emisného zdroja – hliníkárne v Žiari nad Hronom. Podrobnejšiu charakteristiku výskumných plôch uvádzame v tab. 1.

Počas exkurzií sme na výskumných plochách zaznamenávali druhovú diverzitu makromycétov spolu s ich abundanciou plodníc. Okrem toho sme zaznamenávali aj distribúciu plodníc, t.j. počet miest výskytu plodníc makromycétov na danej ploche. Takto sme u každého druhu získali číslo abundancie A (počet plodníc) a číslo distribúcie D (počet miest výskytu plodníc). Po sčítaní oboch charakteristík A + D sme získali číslo dominancie (Do), ktoré daný druh kategorizovalo v stupnici najdominantnejších druhov v mykocenóze výskumnej plochy.

Celkovo sme počas doby výskumu na výskumných plochách zistili 121 druhov makromycétov a jeden druh nedokonalej huby. Početnosť druhov zistených na jednotlivých plochách, ako aj hodnoty abundancie, distribúcie a dominancie makromycétov uvádzame v tab. 2.

Zistili sme pomerne vyrovnané hodnoty abundancie, distribúcie plodníc a dominancie druhov na všetkých troch výskumných plochách. Druhová diverzita v skupine najdominantnejších druhov bola na každej ploche skoro zhodná. Na každej výskumnej ploche sa vyskytovali aj druhy typické iba pre prostredie daného porastu na výskumnej ploche. Najdominantnejšie druhy boli: *Ascodichaena rugosa, Diatrype disciformis, Hypoxylon fragiforme, Valsa ambiens, Pseudovalsa spinifera, Polyporus varius, Stereum hirsutum*. Tieto druhy sa na plochách vyskytovali najčastejšie a dosahovali vysoké hodnoty abundancie a distribúcie plodníc. Z hľadiska ekotrofických nárokov jednotlivých makromycétov možno konštatovať, že u lignikolných parazitov badať pokles diverzity od VMP Žiar nad Hronom po EES Kováčová. Do určitej miery to môže byť spôsobené imisným zaťažením, ktoré je najvyššie na ploche VMP. Všetky parazitické druhy zistené na výskumných plochách uvádzame v tab. 5, z ktorej vidno, že druhy rodu *Nectria* sa na dvoch plochách vyskytovali hromadne a spôsobovali epifytóciu nekrotického ochorenia kôry kmeňov buka. V dôsledku epifytócie dochádzalo k vysokej mortalite bukov najmä na VMP Žiar nad Hronom. Zistili sme pomerne vyrovnaný počet lignikolných saprofytov a terestrických saprofytov na každej výskumnej ploche. Negatívny vplyv imisií sa odráža aj na druhovom spektre ektomykoríznych makromycétov (iba šesť druhov na VMP a 21 druhov na EES – tab. 4).

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