ISSN 1211-8788 *Acta Musei Moraviae, Scientiae biologicae* (Brno)
85: 355–363, 2000

A mycocoenological study of ectomycorrhizal macromycetes in floodplain forests in southern Moravia

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ANTONÍN V. 2000: A mycocoenological study of ectomycorrhizal macromycetes in floodplain forests in southern Moravia. *Acta Musei Moraviae, Scientiae biologicae* (Brno) **85:** 355–363. – A list is given of ectomycorrhizal macromycetes recorded in ten permanent plots in floodplain forests in southern Moravia (Czech Republic). It contains 56 species belonging especially to the genera *Amanita*, *Cortinarius*, *Hebeloma, Inocybe, Lactarius, Russula*, and *Xerocomus*. The numbers of mycorrhizal, lignicolous and terrestrial species and the ratios between them are studied and compared with the scale of ectotrophic forest stability disturbance. This comparison showed that two plots (locality Myslivcova louka) are at the start of the latent phase of disturbance, while others are already in the acute and transient to lethal phase, or in the lethal phase. The value of the ectotrophic forest stability disturbance scale (FELLNER 1993, FELLNER & PEŠKOVÁ 1995) for floodplain forests is discussed.

Key words: macromycetes, floodplain forests, ecology, ecological stability

Introduction

Floodplain forests are among the most important habitats for biodiversity in Central Europe. The most important complex of floodplain forests in the Czech Republic is found along the Morava and Dyje rivers in southern Moravia.

Disturbance of forest ecosystems has been noted throughout Europe in the past few decades. Mycorrhizal fungi have been described as very suitable bioindicators of air pollution and of disturbance in forest ectotrophic stability (JAKUCS 1985, 1988; FELLNER 1989, 1993). Three stages of disturbance in ectotrophic forest stability are linked directly to particular phases of impoverishment of ectomycorrhizal mycocoenoses and of enrichment of lignicolous mycocoenoses (FELLNER 1993; FELLNER & PEŠKOVÁ 1995; SOUKUP 1996).

Published results have been obtained from two projects: "Mycological monitoring in European oak forests" (ERBCIPACT930186) and "Mycological monitoring in wetland forests at Pálava, Czech Republic" (Global Environment Facility, Biodiversity Protection Project, Restoration of wetlands at Pálava). The aim of the first project was to monitor forests of four oak species (*Quercus cerris, Q. petraea, Q. pubescens* and *Q. robur*) in three European countries (the Czech Republic, Italy and Poland), and in particular to compare ectomycorrhizal macromycetes in these forests and, from the mycological point of view, to determine the phase of disturbance based on the abundance of mycorrhizal fungi. Wetland associations in the region of the planned enlargement of the Pálava Landscape Protected Area were studied in the second project.

	Mysliv. louka 1	Mysliv. louka 2	Křivé jezero 1-2	Křivé jezero 2-1	Ranšpurk 2	Ranšpurk 1	Křivé jezero 1 -1	Křivé jezero 2-2	Cahnov 2	Cahnov 1	Total frequency
Number of species in each plot	33	29	20	15	12	11	8	8	7	3	56
% of mycorrhizal species in each plot	36.7	32.9	26.0	20.9	10.3	9.7	14.3	15.4	7.7	3.6	-
Laccaria affinis	3/6	2/4	1/1	2/2	2/4	1/1	1/1	1/2	2/2	1/1	X
Scleroderma areolatum	3/6	3/7	3/6	3/8	4/4	1/1	3/6	2/4	2/1	1/1	X
Inocybe geophylla var. *geophila*	1/3	1/3	1/1	3/1	-	1/1	1/2	1/1	1/1	-	VIII
Russula risigallina	1/1	1/1	9/4	1/1	-	1/1	1/1	1/1	1/1	-	VIII
Inocybe geophylla var. *lilacina*	2/5	3/10	1/2	1/1	2/3	2/2	-	-	-	-	VI
Xerocomus chrysenteron	-	1/1	1/4	-	1/1	-	1/1	-	1/1	-	V
Xerocomus rubellus	3/5	1/3	2/6	2/3	-	-	-	1/2	-	-	V
Cortinarius (*Telamonia*) sp. 2	3/9	2/4	1/2	1/3	-	-	-	-	-	-	IV
Hebeloma aestivale	-	-	1/1	1/1	-	-	1/1	1/2	-	-	IV
Inocybe rimosa	1/2	1/1	1/2	-	-	-	-	1/1	-	-	IV
Lactarius circellatus	1/1	1/1	1/2	-	-	2/2	-	-	-	-	IV
Russula livescens	-	1/2	1/1	1/2	1/1	-	-	-	-	-	IV
Russula vesca	1/1	1/1	-	-			-	-	1/1	1/1	IV
Cortinarius (*Telamonia*) sp. 1	-	-	1/1	1/2	-	1/2	-	-	-	-	III
Lactarius decipiens	3/8	2/5	-	-	1/1	-	-	-	-	-	III
Russula fragilis	1/2	1/1	1/2	-	-	-	-	-	-	-	III
Russula mairei	1/4	1/1	-	1/1	-	-	-	-	-	-	III
Xerocomus spadiceus	-	1/1	1/2	-	-	-	1/1	-	-	-	III
Amanita fulva	1/1	-	-	-	1/1	-	-	-	-	-	II
Amanita lividopallescens	1/3	-	1/2	-	-	-	-	-	-	-	II
Amanita vaginata	1/3	-	1/1	-	-	-	-	-	-	-	II
Cortinarius duracinus	2/5	1/2	-	-	-	-	-		-	-	II
Hebeloma cf. *vaccinum*	2/1	1/4	-	-	-	-	-	-	-	-	II
Hebeloma pallidoluctuosum	1/1	-	-	1/1	-	-	-	-	-	-	II
Inocybe praetervisa	1/2	1/2	-	-	-	-	-	-	-	-	II
Inocybe sp. 1	1/1	1/1	-	-	-	-	-	-	-	-	II
Laccaria amethytea	-	-	3/1	-	-	1/1	-	-	-	-	II
Lactarius azonites	1/4	1/3	-	-	-	-	-	-	-	-	II
Lactarius fulvissimus	1/4	1/1	-	-	-	-	-	-	-	-	II
Russula odorata	1/2	-	2/3	-	-	-	-	-	-	-	II

Tab. 1. A list of mycorrhizal macromycetes in the permanent plots in floodplain forests in Southern Moravia.

Russula graveolens	1/2	-	-	-	-	1/1	-	-	-	-	-	II
Russula grisea	1/2	2/7	-	-	-	-	-	-	-	-	-	II
Russula luteotacta	1/4	1/1	-	-	-	-	-	-	-	-	-	II
Russula cf. *minutula*	1/2	1/1	-	-	-	-	-	-	-	-	-	II
Xerocomus fragilipes	-	-	-	-	-	1/1	1/1	-	-	-	-	II
Amanita ceciliae	-	1/1	-	-	-	-	-	-	-	-	-	I
Amanita gemmata		-	-	-	1/1	-	-	-	-	-	-	I
Amanita mairei	1/1	-	-	-	-	-	-	-	-	-	-	I
Amanita rubescens	-	-	-	-	1/1	-	-	-	-	-	-	I
Cortinarius alboviolaceus	-	-	-	-	-	-	-	1/1	-	-	-	I
Cortinarius (Telamonia) sp. 3	-	-	-	-	1/1	-	-	-	-	-	-	I
Cortinarius (Telamonia) sp. 4	-	-	-	2/2	-	-	-	-	-	-	-	I
Hebeloma cf. *velutipes*	-	-	-	-	-	-	-	-	1/2	-	-	I
Hebeloma cf. *longicaudum*	-	-	-	1/1	-	-	-	-	-	-	-	I
Inocybe asterospora	1/1	-	-	-	-	-	-	-	-	-	-	I
Inocybe salicis	-	-	-	1/2	-	-	-	-	-	-	-	I
Inocybe sindonia	1/1	-	-	-	-	-	-	-	-	-	-	I
Lactarius quietus	-	-	1/1	-	-	-	-	-	-	-	-	I
Paxillus involutus	-	-	-	-	-	1/1	-	-	-	-	-	I
Russula chloroides	1/2	-	-	-	-	-	-	-	-	-	-	I
Russula lepida	-	1/1	-	-	-	-	-	-	-	-	-	I
Russula pseudointegra	1/2	-	-	-	-	-	-	-	-	-	-	I
Russula velenovskyi	-	1/1	-	-	-	-	-	-	-	-	-	I
Scleroderma bovista	-	-	-	-	1/1	-	-	-	-	-	-	I
Tricholoma sejunctum	-	1/2	-	-	-	-	-	-	-	-	-	I
Tricholoma scalpturatum	-	-	-	-	2/1	-	-	-	-	-	-	I

Tab. 1 (continued). A list of mycorrhizal macromycetes in the permanent plots in floodplain forests in Southern Moravia.

Methods

Macromycetes were regularly collected at about four-week intervals over a period of three years (1994–1996), from the second half of April to the first half of November, in rectangular permanent plots of 1000 m^2. Ten permanent plots were studied, located in pairs in the following localities in southern Moravia: Křivé jezero National Nature Reserve (near Nové Mlýny, Břeclav distr.; in two parts of the locality, totalling four plots), Ranšpurk and Cahnov National Nature Reserves (near Lanžhot, Břeclav distr.), and Myslivcova louka (near Lanžhot, Břeclav distr.). Permanent plots selected in areas of homogenous stand were divided into ten subplots of 100 m^2. All plots were homogenous from a phytosociological point of view. The mycological surveys covered only those epigeous macromycetes visible to the naked eye (i.e. larger than about 5 mm). At each visit, the species diversity of macrofungi, their abundance (estimated number of fruit bodies) in the whole permanent plot and the frequency of findings in the subplots were recorded. Finally, we calculated the number of carpophores on each plot divided by the frequency (number of subplots with mentioned species).

For the total estimate of abundance, the average of three annual maximum abundance figures was calculated and the scale proposed by ARNOLDS (1981) was applied. This scale was slightly modified: if only one or two carpophores were collected (average 0.66, resp. 0.33 "carpophores per year"), an abundance figure of "1" was included in the table (according to Arnold´s original scale, abundance "1" meant 1–3 carpophores). This abundance figure was divided by the maximal number of subplots in which carpophores were found (a partial frequency) in a summarizing table. For the total frequency, the scale proposed by KEIZER (1993) was used.

From a phytosociological point of view, the Křivé jezero plots belong in the association *Fraxino pannonicae-Ulmetum* SOÓ in ASZÓD 1936 corr. SOÓ 1963 (CHYTRÝ in litt.), the other plots in the association *Fraxino pannonicae-Ulmetum carpinetosum* (SIMON 1957) DŽATKO 1972 (VICHEREK et al. 1999). *Quercus robur* and *Fraxinus angustifolia* represent the dominant trees; also very common are *Acer campestre*, *Carpinus europaeus*, *Crataegus* spp., and *Ulmus campestris*. From the point of view of forestry phytocoenology, the forests in Cahnov and Ranšpurk belong in the association *Querceto-Fraxinetum deschampsietum caespitosae* (VRŠKA 1997, 1998).

The nomenclature used is according to MOSER (1983).

Results

All mycorrhizal species collected are included in table 1. In total 56 species were recorded. The most frequently noted genera were *Russula* (14 species), *Inocybe* (8), *Amanita* (7), *Cortinarius* (6), *Hebeloma* (5), *Lactarius* (5), and *Xerocomus* (4); species of other genera were found only rarely: *Tricholoma, Laccaria, Scleroderma* (2) and *Paxillus* (1). Two species, *Laccaria affinis* and *Scleroderma areolatum*, were found in all plots. Five taxa, *Inocybe geophylla* var. *geophylla*, *Russula risigallina* (both in 80 % of plots), *Inocybe geophylla* var. *lilacina* (60 %), *Xerocomus chrysenteron* and *X. rubellus* (50 %)

were collected in at least half the plots. However, some species with rather low total frequency were very common in some plots, e. g. *Lactarius decipiens, Russula grisea* and *Cortinarius duracinus* in the Myslivcova louka plots.

The highest number of mycorrhizal species (Tab. 2, figs. 1 and 2) was recorded in both the Myslivcova louka plots (33 and 29; which is 36.7 % resp. 32.9 % of all macromycetes), distinctly fewer taxa of ectotrophic macromycetes were found in Křivé jezero 1–2 [20 species (= 26 %)], and Křivé jezero 2–1 [15 species (= 20.9 %)], Ranšpurk 2 and 1 (12, resp. 11 species, representing 10.3 %, resp. 9.7 %), Křivé jezero 1–1 and 2–2 (8 species; 14.3 %, resp. 15.4 %); only a few mycorrhizal species were noted in both Cahnov plots [7 (= 7.7 %), resp. 3 species (= 3.6 %)]. The total number of species in the last plot may be partly influenced by its proximity to a meadow, making the plot subject to wind disturbance.

Tab. 2. Fungi of basic trophic groups in all plots.

Macromycetes	Lignicolous		Mycorrhizal		Terrestrial		Number of species
plot	Num.	%	Num.	%	Num.	%	
Cahnov 1	66	77.6	3	3.6	16	18.8	85
Cahnov 2	72	79.1	7	7.7	12	13.2	91
Křivé jezero 1–1	38	67.9	8	14.3	10	17.8	56
Křivé jezero 1–2	42	54.5	20	26.0	15	19.5	77
Křivé jezero 2–1	41	56.9	15	20.9	16	22.2	72
Křivé jezero 2–2	29	55.8	8	15.4	15	28.8	52
Myslivcova louka 1	44	48.9	33	36.7	13	14.4	90
Myslivcova louka 2	44	50.0	29	32.9	15	17.1	88
Ranšpurk 1	85	75.2	11	9.7	17	15.1	113
Ranšpurk 2	85	73.3	12	10.3	19	16.4	116

Discussion

LUSCHKA (1997) published a report on macrofungi in the central German floodplain forests of the *Alno-Ulmion* containing ca. 13 % of ectomycorrhizal fungi (an exact list of species was not included). In contrast to our plots, alder (*Alnus*) was present in his plots together with its mycorrhizal partners. He mentioned only one fungus typical of floodplain forests, *Xerocomus rubellus.* According to Luschka, the presence of *Inocybe, Laccaria* and *Hebeloma* species indicated young or disturbed stands, while *Scleroderma* and *Xerocomus* species (except *X. rubellus*) represented species indifferent to their growth area. BUJAKIEWICZ (1992) recorded only 4 % of mycorrhizal species in the *Ficario-Ulmetum campestris* association in Poland, whereas FLISIŃSKA (1988) recorded almost 18 % in the *Carici elongatae-Alnetum* association, and BUJAKIEWICZ (1997) 16 % in the *Violo odoratae-Ulmetum* association. In his extensive study, EINHELLINGER (1973) mentioned 8.1 % of mycorrhizal species for park-like growth of *Fraxino-Ulmetum* association, 7.0 % for typical *Fraxino-Ulmetum* and *Alnetum incanae loniceretosum*

associations, only 1.4 % for *Alnetum incanae typicum* and *Ligustro-Prunetum salicetosum purpureae* associations in Germany.

Comparing the mycorrhizal fungi with the scale of ectotrophic forest stability disturbance (FELLNER 1993, FELLNER & PEŠKOVÁ 1995; Tab. 3), our results are quite pessimistic. The forest stand in the Myslivcova louka plots is at the start of the latent phase of disturbance, the stand in the Křivé jezero plots is already in the acute and transient to lethal phase, while the stand in the other plots is already in the lethal phase. Similar results were published by SOUKUP (1997) for some of these plots. However, the scale is based on "normal" stands without a high level of underground water and can also be used for places not preserved as nature reserves. A high level of underground water in floodplain forests has a negative influence on the growth and fructification of mycorrhizal fungi. Also a large amount of fallen and decaying wood in natural reserves (not removed by man) markedly raises the number of lignicolous species. These factors are among the most important criteria for estimating ectotrophic forest stability (see Tab. 3). Nonetheless, the situation in the forests studied is not optimistic at all.

Tab. 3. The scale of ectotrophic forest stability disturbance (modified from FELLNER 1993, FELLNER & PEŠKOVÁ 1995).

PHASE	CRITERIA
Latent	The percentage of species of ectomycorrhizal fungi in the total count of macromycetes is decreasing to 40 %, while the percentage of lignicolous species is tending to reach more than 30 %.
Acute	Ectomycorrhizal species constitute constantly less than 40 % of the total number of macromycetes, while lignicolous species as a rule constitute more than 40 %.
Lethal	Ectomycorrhizal species constantly constitute less than 20 % of all macromycetes, while lignicolous species as a rule constitute more than 55 %.

Acknowledgements

The author is very grateful to Peter J. Roberts (Kew, England) for the correction of the English manuscript. The research was enabled thanks to the following grants: "Mycological monitoring in European oak forests" (ERBCIPACT 930186) and "Mycological monitoring in wetland forests at Pálava, Czech Republic" (Biodiversity Protection Project/Protected Landscape Area – Biospherical Reservation Pálava).

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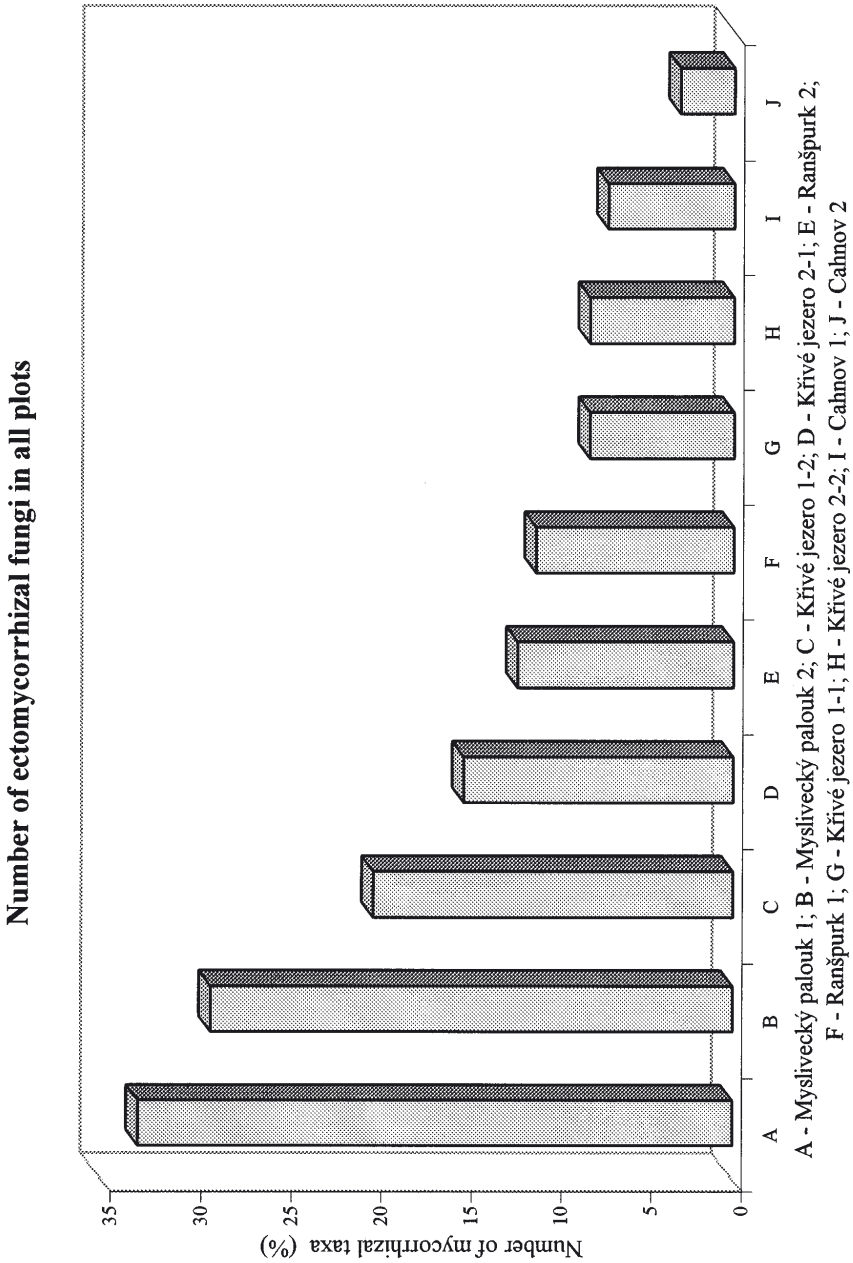

Fig. 1. Number of ectomycorrhizal fungi in all plots.

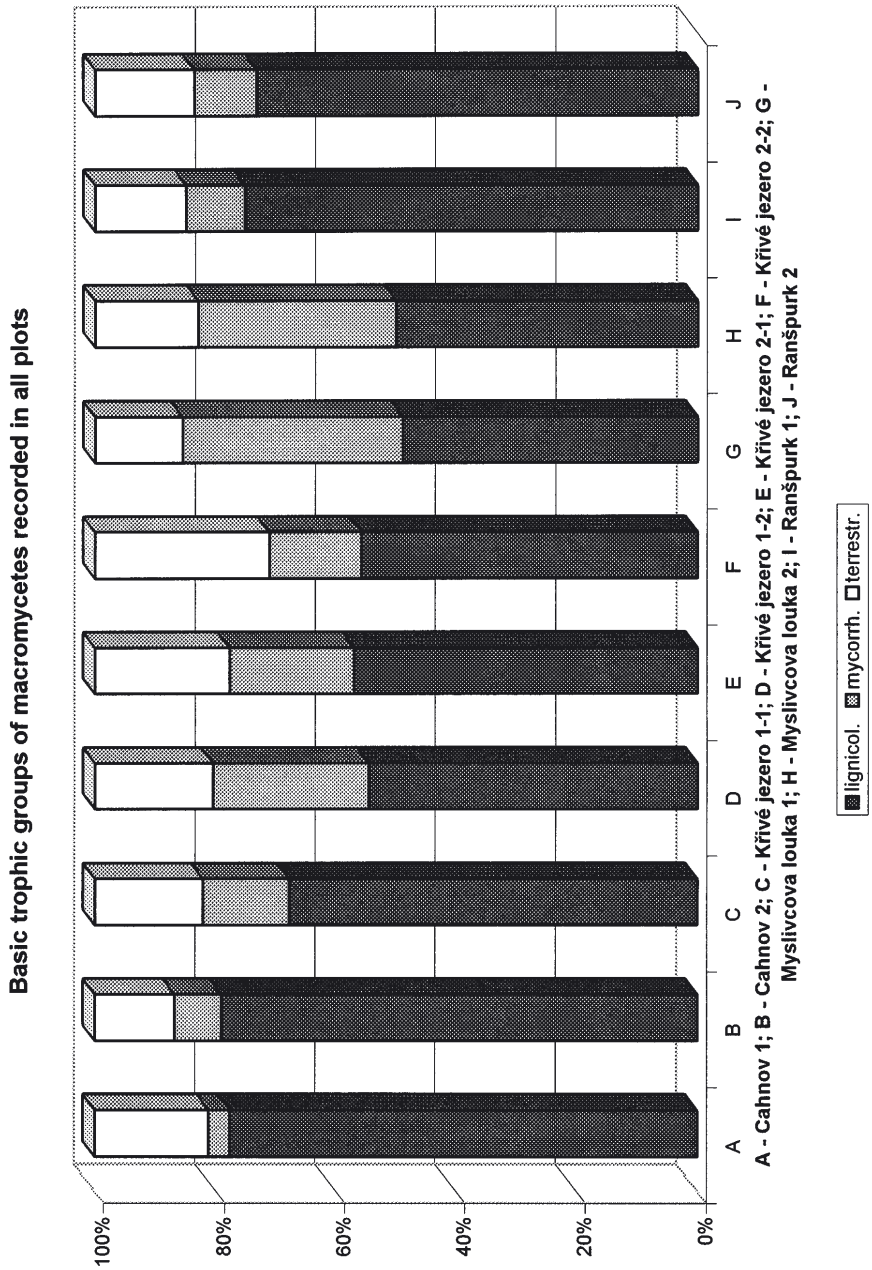

Fig. 2. Basic trophic groups of macromycetes recorded in all plots.