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Macromycetes in the forest communities of the Jodły Łaskie nature reserve (Central Poland)

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K a ł u c k a I.: *Macromycetes in the forest communities of the Jodły Łaskie nature reserve (Central Poland).* Acta Mycol. 30 (1): 3-26, 1995.

The analysis of macromycetes against the background of forest communities is presented in the paper. The relationship between the mycoflora and the exploited habitat – type of phytocoenosis, stand composition, type of substrate, humidity – has been determined referring to ecological groups of fungi. Communities with considerable proportion of fir-tree in stand were particularly taken into consideration.

Key word: Macromycetes.

INTRODUCTION

Forest communities with *Abies alba* Mill. have recently become a subject of keen interest of phytosociologists and mycologists because of the fir decline in Poland. The Jodły Łaskie forest reserve established in 1991 protects the 130-year-old fir-tree stands and phytocoenoses of fir-forest of natural origin, where *Abies* growth and successful spontaneous self-sowing is conspicuous. These communities are of great value as the northern limit of fir-tree distribution close to the reserve. The reserve is also valuable in respect of the model relationships between the types of forest communities and water, geomorphological and edaphical conditions of the habitats (B i g o s, 1991; K u r o w s k i, 1982). In addition, the distinct dependence on the above-mentioned factors and on the type and species composition of phytocoenoses characterizes the mycoflora of this area.

There are only few published mycological studies of the Central Poland area. The most complete work is that of Ł a w r y n o w i c z (1973). The materials to the *Myxomycetes* flora were presented by K a l i n o w s k a - K u c h a r s k a (1975). Mycoflora of natural fir-forests and of forests with considerable proportion of fir-tree in stand in this region has not been the subject of any published studies so far. The publications by B u j a k i e w i c z (1981, 1982), G u m i ń s k a (1966),

L i s i e w s k a (1978), S a ł a t a (1972, 1977, 1978) and W o j e w o d a (1975) concern other regions of Poland.

The aim of this study is to determine the relationships between the species composition of mycoflora and the habitat exploited by fungi: the type of phytocoenosis, the stand composition, the type of substrate and humidity. Particular attention is paid to communities characterized by a considerable proportion of *Abies*. An attempt has been made to reveal the effect of fir-tree presence on macrofungi. The present paper is a mycological documentation of the reserve as well. It seems to be very well-founded task because of the distinct fir-tree decline in Europe.

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DESCRIPTION OF THE STUDY AREA

The Jodły Łaskie nature reserve is situated (Fig. 1) in the southern part of Łask Upland, comprising South Wielkopolska Lowland (K o n d r a c k i, 1978). Łask Upland is a denuded moraine plain formed by Pleistocene glaciers. Its climate is influenced by humid masses of the polar-oceanic air from the west and south-west clashing with relatively big masses of the polar-continental air from the east and south-east (D u b a n i e w i c z, 1974). Data on temperature and precipitation are provided in Tab. 1.

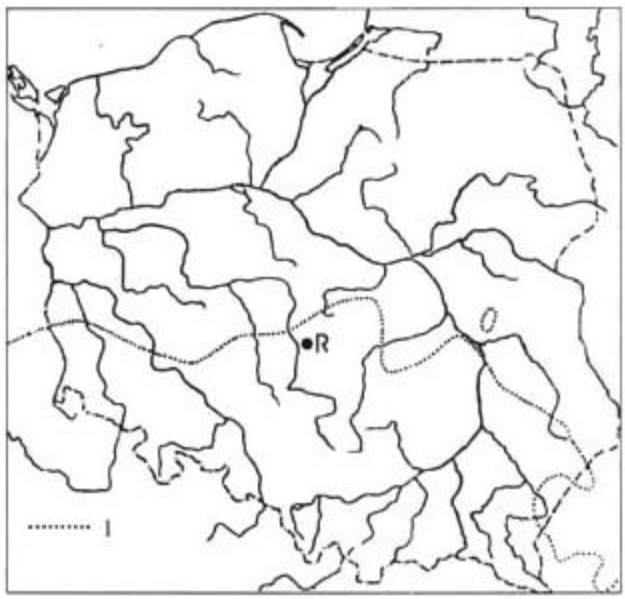

Fig. 1. Geographical location of the Jodły Łaskie forest reserve (R)
1 – north-eastern limit of distribution of *Abies alba* in Poland
(Sałata, 1978; modified)

Table 1

Average monthly temperatures in °C (A) and monthly precipitation in mms (B) during the period of study (Meteorological station at Lublinek)

Years	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I-XII
A													
1951-1980	-3.2	-2.3	1.5	7.2	12.5	16.5	17.9	17.1	13.1	82.0	3.3	-0.8	7.6
1989	1.4	3.8	5.6	8.8	14.1	15.1	18.0	17.9	14.9	10.3	1.5	0.8	9.6
1990	1.4	4.5	6.7	8.4	13.7	16.5	16.7	17.8	11.0	9.4	4.1	-0.6	9.1
1992	-1.0	1.4	3.2	7.6	13.6	18.7	20.1	21.6	12.7	5.8	3.6	-1.1	8.9
B													
1951-1980	28	28	29	36	54	70	89	68	47	38	40	37	564
1989	18	22	16	58	46	82	57	32	12	32	46	40	461
1990	23	29	21	41	27	44	80	45	65	23	80	31	509
1992	17	40	59	33	15	25	48	14	59	46	47	44	447

In the reserve (59.5 ha) acid or very acid podzol soils on clay prevail. They are inhabited mainly by coniferous associations and communities with high proportion of fir. Most of the *Tilio-Carpinetum* phytocoenoses and some communities with fir-trees are found on acid brown earths and grey brown podzolic soils. The remaining types of soils (peat soils on alluvial subsoil, pseudogley soils, typical and degraded meadow black earths) are inhabited mainly by the *Vaccinio uliginosi-Pinetum, Circaeo-Alnetum* and *Ribo nigri-Alnetum* associations. In the upper layers of the soils, sand fraction strongly leached of $CaCO_3$ dominates (Management plan for the Sędziejowice forest inspectorate for the period of 1972-1981). The eastern border of the reserve is the Końska river. For the last few years its course has been regulated and damp fragments of the valley reclaimed. The drain dishes system has been made in the forest, resulting in an excessive accelerated outflow, lowered ground-water level and progressing drainage.

In the area studied nine forest associations were distinguished by B i g o s (1991); two of them – *Tilio-Carpinetum* and *Querco roboris-Pinetum* are furthermore differentiated. Altogether 12 types of forest phytocoenoses were recorded (Fig. 2).

MATERIALS AND METHODS

Mycological investigations were carried out over the period of 1989, 1990 and 1992. Regular observations in 10 permanent plots (10 observations in each of them) were performed in 1990 (VI-X). The plots were selected in the forest communities representing 7 syntaxa: five in the *Tilio-Carpinetum* with regard to its internal differentiation (*Tilio-Carpinetum typicum TCt* – 1 plot; *Tilio-Carpinetum stachyetosum silvaticae* with considerable proportion of *Abies alba TCss Aa* – 2; *Tilio-Carpinetum stachyetosum silvaticae* variant with *Alnus glutinosa TCss Ag* – 2, the remaining five

plots in the coniferous associations (*Abietetum polonicum Ap* – 1; *Querco roboris-Pinetum QrP* – 1; *Querco roboris-Pinetum* variant with *Abies alba QrP Aa* – 2; *Vaccinio uliginosi-Pinetum VuP* – 1). The sample plots were selected on the basis of the uniformity and representativeness of phytocoenoses.

Fig. 2. Distribution of permanent plots (I-X) in the forest associations in the reserve

1 – *Ribo nigri-Alnetum* Soln.-Górn. 1987; 2 – *Circaeo-Alnetum* Oberd. 1953; 3 – *Tilio-Carpinetum typicum* Tracz. 1962; 4 – *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962, variant with *Alnus glutinosa*; 5 – *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962 with *Abies alba*; 6 – *Cladonio-Pinetum* Juraszek 1927; 7 – *Leucobryo-Pinetum* Mat. (1962) 1973; 8 – *Molinio-Pinetum* J. Mat. 1973; 9 – *Vaccinio uliginosi-Pinetum* Kleist 1929; 10 – *Abietetum polonicum* (Dziubałtowski 1928) Br.-Bl. et Vlieg. 1939; 11 – *Querco roboris-Pinetum* J. Mat. 1988; 12 – *Querco roboris-Pinetum* variant with *Abies alba* J. Mat. 1988 (Bigos, 1991; modified)

A sampling area of 400 m^2 (20 m x 20 m) was established; it is regarded as optimal for the mycological research in forests (e.g. N e s p i a k, 1959). For the quantitative characteristics of fungal species the 3-degree scale (J a h n, N e s p i a k, T ü x e n, 1967) was applied: *r* (rares), *n* (numerous), *a* (abundant). The fungi were classified into 3 ecological groups according to the inhabited substrate: terrestrial fungi, litter-decomposing fungi and lignicolous fungi. In some controversial cases when a certain species was found on various substrates, it was assigned to the ecological group in which it was recorded more frequently.

For each ecological group a table showing the occurrence of species against the background of all the investigated associations is presented. It has been assumed, according to A r n o l d s (1992), that abundance (the number of sporocarps of a species observed in a plot on a visit – *r, n, a*) is a factor of greater concern than temporal frequency (the number of visits on which a species was observed in a plot

during the mycological analysis). A synthetical measure of the absolute maximum abundance of carpophores is regarded as most appropriate to estimate the potential fruiting capacity of a species. Therefore, maximum abundance of carpophores followed by temporal frequency has been applied in the summary tables; in the last column spatial frequency (the number of plots in which a species was observed) has been indicated. The similarity of plots in respect of the fungal species composition was considered as a basic criterion of the table layouts. Such a system reflects the natural ranges of ecological demands of species as well as their relationships with plant associations and habitat conditions. Certain groups of fungi, displaying habitat preferences or the lack of them can be distinguished.

The herbarium collection of fungi has been deposited in the Herbarium Universitatis Lodziensis (LOD).

MACROMYCETES AGAINST THE BACKGROUND OF FOREST COMMUNITIES AND SOME ECOLOGICAL FACTORS

Description of the plots

Plot I. *Tilio-Carpinetum typicum* Tracz. 1962

Stand (85 % coverage): *Carpinus*, solitary *Tilia*, *Alnus*, *Betula*. Brushwood layer (20 %): *Corylus*, *Frangula*. Herb layer (70 %): herbaceous plants, seedlings of *Sorbus*, *Quercus*, *Betula*, *Carpinus*, *Populus*, *Abies*, *Frangula*. Mosses: only on stumps, logs and on the bases of tree trunks. Numerous dead standing trunks and fallen branches.

Plot II. *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962 with *Abies alba*

Two-layer stand (90% coverage): a_1 – *Pinus*, *Abies*, *Betula*, a_2 – *Carpinus*. Brushwood layer (10 %): *Carpinus*, *Frangula*, solitary *Sorbus*, *Quercus*, *Picea*, *Abies*. Herb layer (50 %): herbaceous plants, seedlings of *Carpinus*, *Abies*, *Picea*, *Quercus*. Mosses: small patches on the ground, on rotting wood and on the bases of tree trunks. Numerous stumps, logs and fallen branches.

Plot III. *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962 with *Abies alba*

Two-layer stand (75 % coverage): a_1 – single, monumental size *Quercus*, a_2 – *Carpinus*. Brushwood layer: lacking. Herb layer (70 %): herbaceous plants, seedlings of *Abies*, *Sorbus*, *Betula*, *Carpinus*, *Quercus*, solitary *Fagus*. Mosses: mainly on rotting wood, on stumps and on the bases of trunks. Large patches of bare litter, numerous stumps and fallen branches.

Plot IV. *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962, variant with *Alnus glutinosa*

Two-layer stand (85 % coverage): a_1 – *Alnus*, solitary *Ulmus*, *Abies*, *Betula* and monumental specimen of *Quercus*, a_2 – *Carpinus*. Brushwood layer (50 %):

Carpinus, single *Picea* and *Ulmus*. Herb layer (60 %): herbaceous plants, seedlings of *Quercus*, *Carpinus*, *Picea*, *Abies*, *Tilia*. Mosses: on stumps, logs and trunks bases. Numerous fallen branches.

Plot V. *Tilio-Carpinetum stachyetosum silvaticae* Tracz. 1962, variant with *Alnus glutinosa*

Situated in a slightly more humid patch than plot IV. Two-layer stand (85 % coverage): a_1 – *Alnus*, solitary *Abies*, a_2 – *Carpinus*. Brushwood layer (15 %): *Abies* with low proportion of *Carpinus*, *Picea* and *Ulmus*. Herb layer (60 %): herbaceous plants, seedlings of *Carpinus*, *Abies*, *Picea*, *Ulmus*, *Tilia*. Numerous stumps, logs and fallen branches, partly covered by mosses.

Plot VI. *Abietetum polonicum* (Dziubałtowski 1928) Br.-Bl. et Vlieg. 1938

Stand (100 % coverage): young *Abies* trees. On one of the plot borderlines 130--year-old fir-trees, pines and birches are found. Brushwood layer: only in few light exposed places, *Sorbus*, *Betula*, *Populus*, *Abies* and *Picea*. Herb layer: poorly developed – a few species associated with coniferous forests, seedlings of *Abies*, *Picea*. Moss layer: very rich in some places. Numerous logs, stumps and fallen branches, mainly of fir-tree and spruce.

Plot VII. *Querco roboris-Pinetum* J. Mat. 1988

Stand (70 % coverage): *Pinus*, *Quercus*, in the vicinity *Betula* is also found. Brushwood layer (20 %): *Frangula*, *Sorbus*, *Populus*, solitary *Juniperus*. Herb layer (80 %): multi-species with predominant *Vaccinium myrtillus*, seedlings of *Quercus*, *Populus*, *Sorbus*. Pine seedlings were not recorded; according to B i g o s (1991) it might be an evidence of the deciduous character of the habitat. Moss layer: poorly developed on trunk bases, stumps and in few humid places. Numerous stumps, fallen branches, plentiful litter.

Plot VIII. *Querco roboris-Pinetum* J. Mat. 1988, variant with *Abies alba*

Stand (40 % coverage): *Quercus*, *Abies*, *Pinus*, *Picea*. Brushwood layer (70 %): *Abies*, *Picea*, *Sorbus*, *Betula*, *Populus*, *Frangula*. Herb layer (70 %): herbaceous plants, seedlings of *Abies*, *Betula*, *Populus*, *Pinus*, *Quercus* and *Sorbus*. Moss layer: plenteous, in some places *Sphagnum* species appear. Numerous logs, stumps and fallen branches.

Plot IX. *Querco roboris-Pinetum* J. Mat. 1988, variant with *Abies alba*

Stand (40 % coverage): *Betula*, *Quercus*, *Pinus*, *Picea; Abies* grows in close vicinity. Brushwood layer (75 %): *Frangula*, solitary *Picea*, *Quercus*, *Alnus* and *Salix*. Herb layer (70 %): considerable proportion of sedges (mainly *Carex fusca*) and other species of moist habitats, seedlings of *Quercus*, *Betula*, *Frangula*, *Picea*, *Abies*. Moss layer: plenteous, in some places species of *Sphagnum* are found. Numerous stumps, logs and branches.

Plot X. *Vaccinio uliginosi-Pinetum* Kleist 1929

Stand (100 % coverage): young pines. Brushwood layer (15 %): *Betula*, scattered *Sorbus*, *Salix*. Herb layer (20 %): mainly *Vaccinium myrtillus* and *V. vitis-idaea*, solitary *V. uliginosum*, seedlings of *Betula*, *Sorbus*. Mosses: in some places on the ground and on stumps, *Sphagnum* species absent. Subsoil: strongly podzolized, gleyed and wet sand, lack of peat. Numerous fallen branches and pine stumps.

Terrestrial fungi

This group is represented by mycorrhiza formers and saprophytic fungi inhabiting soil humus.

In the course of the research no soil analyses were performed. However, according to the forest inspectorate soil statement, the coniferous forest communities and the communities with *Abies* in stand inhabit mainly acid and very acid podzols, while the *TCss Ag* patches occur on black earths in the wet habitats characterized by higher pH values. The dependence of some fungi on soil acidity can be demonstrated against the background of this diversification. The species associated with strongly acid soils (T y l e r, 1989) occur exclusively, mainly or with the highest abundance in the reserve in the coniferous communities and in communities with *Abies*. These are: *Clitocybe clavipes*, *C. dealbata*, *Cortinarius hemitrichus*, *Lactarius camphoratus*, *L. quiteus*, *L. theiogalus*, *Russula fellea*, *R. fragilis*, *R. ochroleuca*. The species preferring soils characterized by higher pH (l.c.) were recorded in the *TC* association, mainly or exclusively in *TCss*, most frequently in the wet variant with *Alnus glutinosa*. These are: *Clavulina cristata*, *Inocybe geophylla*, *Laccaria laccata*, *Lactarius circellatus*, *Mycena pura*.

Humidity is a very important factor determining the presence of some species. Most of the plots were characterized by relatively high humidity, which favoured the occurrence of species associated with humid habitats – *Coprinus* spp., *Galerina* spp., *Hebeloma magnimamma*, *H. testaceum*, *Inocybe napipes*, *Laccaria proxima*, *Lactarius circellatus*, *L. helvus*, *L. lilacinus*, *L. omphaliformis*, *L. pubescens*, *L. theiogalus*, *Psathyrella* spp., *Rusulla emetica*, *R. fragilis*, *R. puellaris*, *R. pumila*. Most of them occurred in the *TCss* subassociation.

The occurrence of fungi depends also on climatic factors, especially on precipitation and temperature. In 1989 and 1992 low precipitation and prolonged drought period almost completely inhabited the sporocarp production. In 1990 the mean monthly temperatures did not differ generally from the averages from many years (Tab. 1). September, which was a bit cooler, but abounding with rainfall, was the culmination period for the fruit production. In October there was a decrease in the species number caused by the rapid and considerable drop in precipitation. In August and at the beginning of September a characteristic disturbance in sporocarp production occurred

in most of the plots. It was connected with the decrease of rainfall in August, which was much more below the average from many years. The dependence of the number of terrestrial species on precipitation is most pronounced in plots II and V. This was probably attributed to the presence of drain dishes in the closest vicinity of both of them, which caused accelerated outflow and faster drying of the upper soil layer. Fungi as sensitive ecological indicators, react quickly to the changes in the water balance in communities characterized by high moisture level. In most of the plots studied the summer and autumn aspects were observed.

The type and degree of relationship between macrofungi and plant communities ware the subject of wide discussions (in Polish literature – e.g. Bujakiewicz, 1973, 1981, 1982; Bujakiewicz, Fiebich, 1991-1992; Gumińska, 1966; Kornaś, 1957; Lisiewska, 1965, 1974, 1978; Ławrynowicz, 1973; Nespiak, 1959, 1968; Sałata, 1972; Wojewoda, 1975). It is widely considered that fungi growing on the ground are strongly associated with phytocoenosis. In many cases it is possible to create a list of characteristic and differential fungal species, that may be regarded as the supplement to the similar list of plant species. In a few cases they may be distinguished even at the level of subassociation (Arnolds, 1992). These species display diagnostic value in the phytosociological sense, therefore they should be characterized by a high fidelity rather than constancy towards the association. It is difficult to point out such species among fungi as they display a broader spectrum of occurrence than vascular plants growing in the same communities. Distinguishing the species locally characteristic or characteristic for syntaxa higher in rank is a relatively easier task, whereas distinguishing the species characteristic of association is very difficult and in many cases impossible (Wojewoda, 1975).

On the basis of the presented observations it is not possible to determine the type and degree of dependence of particular species on plant communities which they accompany, their attachment to certain associations and, furthermore, to distinguish the species locally characteristic. However, the analysis of the collected material supported by data from literature may provide some information about the macromycetes of the area studied and reveal some trends in their occurrence.

In total 85 terrestrial fungi were recorded in 10 sample plots in the reserve. They can be divided into 4 relatively distinct groups (Tab. 2):

A. Ubiquitous species (15 %). They appear in the deciduous as well as in the coniferous patches, displaying no preferences towards the type of plant association. These fungi, having broad ecological amplitude, occur commonly in various types of woods. Most of them were fruiting abundantly and with high temporal frequency. These are mainly mycorrhizal fungi associated with a certain host tree and display no apparent associacion the type of phytocoenosis but with the presence of a host. A classic example is *Lactarius quietus*, which is associated with oak.

B. Species with the centre of occurrence in the coniferous communities (15 %). The fungi in this group display fairly broad

ecological range. Only 5 of 13 species were recorded exclusively in the patches of coniferous and mixed wood. The remaining species were found also in the plots localized in *TCss Aa*. These fungi are not associated with the type of community but are dependent on the stand composition; they accompany coniferous trees. This group of species is responsible for the evident mycological similarity of the patches of *TCss Aa, QrP, QrP Aa* and *Aa*. The similarity is amplified by the high humidity of the habitats, resulting in the presence of hygrophilous species.

C. Species with the centre of occurrence in the *TC* association (19 %). The fungi in this group are characterized by a narrower spectrum of occurrence. Only 2 of 14 species were recorded outside *TC* (*Laccaria amethystina* and *Russula vitellina).* Nevertheless, they attain here the highest abundance and frequency of occurrence.

This group reveals the presence of humidity gradient within the limits of the *TC* association and displays the continuity in moisture level changes and no sharp limits between the syntaxa. These observations confirm the continuous character of differences between the subassociations and variants, and their sharpening between the extreme communities (Ławrynowicz, 1973).

The changes in humidity conditions and in the character of phytocenoses in the plots result in changes in the mycoflora. *Naucoria scolecina, Lactarius omphaliformis* and *L. lilacinus* (*TCss Ag*) are species typical of wet habitats, and are strongly associated with floodplain forests and alder (e.g. Bujakiewicz, 1973, 1992). *Clavulina cristata, Russula alutacea* and *Cortinarius alboviolaceus* (*TCss Ag, TCss Aa)* are most frequently found in deciduous forests, while *Russula cyanoxantha, R. foetens* and *R. nigricans* (*TCss Aa, TCt*) are recorded in both deciduous and coniferous forests. The decrease in the mycofloral specificity that accompanies the decrease in the specificity of a phytocoenosis and habitat conditions is therefore evident.

D. Exclusive species – recorded in one plot only (51 %). The configuration of these species in Tab. 2 confirms the conclusion submitted above. In the plots representing the *TC* association, the number of exclusive species distinctly decreases in the sequence from the most to the least specific patches: 45 % – the more humid plot representing *TCss Ag*; 36 % – the drier plot in this community; 33 % – *TCt*; 21 % and 4.5 % – the patches of *TCss Aa*. The communities of *QrP* and *QrP Aa* are far less specific – the number of exclusive terrestrial fungi varies in the range of 5-8 %. However, in the patch of *VuP* the number of these species attains 40 %. High specificity of this association was pointed out by Nespiak (1959) and Lisiewska (1978). The second conspicuous coniferous association is *Ap*, where exclusive species comprise 33 % of the terrestrial fungi. The gradient of exclusive species reveals clearly a considerable influence of the stand composition – the more specific it is, the more specific is its mycoflora.

Table 2

Terrestrial fungi in the respective plots and forest communities
(For details see page 5-7)

Group	Association	TCss Ag	TCss Ag	TCss Aa	TCss Aa	TCt	QrP Aa	QrP Aa	QrP	Ap	VuP	Spatial fre-
	No of plot	V	IV	III	II	I	IX	VIII	VII	VI	X	quen-
	Number of species	11	22	22	28	18	12	20	21	30	10	cy
A	*Paxillus involutus* (Batsch) Fr.	.	r3	n3	n2	r3	a3	n5	a5	a4	n2	9
	Russula ochroleuca (Pers.) Fr.	.	r1	r2	r3	r2	r2	a1	a3	a6	.	8
	Lactarius theiogalus (Bull.) Fr.	.	n2	n1	n1	.	n3	n3	a3	a4	.	7
	Xerocomus badius (Fr.) Kühn. ex Gilb.	r1	n2	r2	r2	.	.	r2	r3	n5	.	7
	Amanita citrina (Schaeff.) S. F. Gray	.	r1	r1	r1	r4	.	r1	r4	r1	.	7
	Lactarius quietus Fr.	.	r4	n3	.	n3	n6	r2	a7	.		6
	Laccaria laccata (Scop.: Fr.) Berk. et Br.	.	r2	a5	n3	r2	.	.	a1	.	.	5
	Amanita fulva (Schaeff.) Pers.	.	.	r1	r3	.	r1	r1	r4	r6	.	6
	Hebeloma crustuliniforme (Bull.: Fr.) Quél.	.	.	n1	a4	r1	n1	.	a1	.	.	5
	Amanita spissa (Fr.) Kummer	.	.	r1	r5	.	.	r1	r1	.	.	4
	Lycoperdon nigrescens Pers.: Pers.	.	.	r2	.	.	.	.	r2	.	.	2
	Russula livescens (Batsch) Quél.	.	.	.	r1	.	.	r1	.	.	.	2
	Lycoperdon perlatum Pers.: Pers.	.	a4	.	.	.	.	r1	.	.	r1	3
B	*Cystoderma amiantinum* (Scop.: Fr.) Fayod	.	.	r2	.	.	r2	r1	n1	a3	.	5
	Laccaria proxima (Boud.) Pat.	.	.	n2	.	.	a7	n2	.	n2	.	4
	Russula fragilis (Pers.: Fr.) Fr. s.s. Schaeff.	.	.	n3	.	.	.	r3	r1	.	n4	4
	Lactarius mitissimus Fr.	.	.	r1	.	r1	.	.	.	n1	.	3
	Hygrophoropsis aurantiaca (Wulf.: Fr.) R. Maire	.	.	.	r2	.	n3	r2	r1	r2	.	5
	Russula emetica v. betularum (Hora) Romagn.	.	.	.	r1	.	r1	r2	r1	r1	.	5
	Russula fellea (Fr.) Fr.	.	.	.	r1	.	.	a1	r1	n2	.	4
	Tylopilus felleus (Bull.: Fr.) P. Karsten	.	.	.	r1	.	.	r2	.	n6	.	3
	Amanita porphyria (Alb. et. Schw.: Fr.) Secr.	.	.	.	.	.	.	r3	.	r4	.	2
	Russula emetica Fr.	.	.	.	.	.	.	r1	r1	r2	r1	4
	Lactarius rufus (Scop.) Fr.	.	.	.	.	.	.	.	r1	n4	a8	3
	Clitocybe clavipes (Pers.: Fr.) Kummer	.	.	.	.	.	.	.	r2	r1	r1	3
	Lactarius subdulcis Bull.: Fr.	.	.	.	.	.	.	.	n2	r1	.	2
C	*Laccaria amethystina* (Bolt.: Hook.) Murr.	.	.	.	n2	n1	.	.	.	r2	.	3
	Russula vitellina (Pers.) Fr.	.	.	r2	n6	.	r1	.	.	.	.	3
	Entoloma sericeum (Bull.: Mérat) Quél.	.	.	.	a1	.	.	.	.	r1	.	2
	Calvatia excipuliformis (Schaeff.: Pers.) Perdeck	.	.	r1	.	r1	.	.	.	.	.	2
	Russula foetens Fr.	.	.	.	a3	r1	.	.	.	.	.	2
	Russula cyanoxantha (Schaeff.) Fr.	.	.	.	r1	r1	.	.	.	.	.	2
	Russula nigricans (Bull.) Fr.	.	.	.	r1	r1	.	.	.	.	.	2
	Lactarius circellatus Fr.	r1	.	.	r2	.	.	.	.	.	.	2
	Russula lilacea Quél.	.	.	r1	r2	.	.	.	.	.	.	2
	Cortinarius alboviolaceus (Pers.: Fr.) Fr.	.	.	r1	r1	.	.	.	.	.	.	2
	Clavulina cristata (Fr.) Schroeter	.	n1	r2	.	.	.	.	.	.	.	2
	Russula alutacea (Pers.: Fr.) Fr.	.	r2	r1	.	.	.	.	.	.	.	2
	Naucoria scolecina (Fr.) Quél.	n1	a2	.	.	.	.	.	.	.	.	2

cont. Tab. 2

	Lactarius omphaliformis Romagn.	n6	r1	.	.	.	.	.	.	.	.	2
	Lactarius lilacinus (Lasch) Fr.	r1	n3	.	.	.	.	.	.	.	.	2
	Mycena pura (Pers.: Fr.) Kummer	r2	r1	.	.	.	.	.	.	.	.	2
D	*Psathyrella candolleana* (Fr.) R. Maire	a2	.	.	.	.	.	.	.	.	.	1
	Coprinus sp.	r2	.	.	.	.	.	.	.	.	.	1
	Leccinum griseum (Quél.) Singer	r2	.	.	.	.	.	.	.	.	.	1
	Coprinus plicatilis (Curt.: Fr.) Fr.	r1	.	.	.	.	.	.	.	.	.	1
	Leccinum versipelle (Fr.) Snell	r1	.	.	.	.	.	.	.	.	.	1
	Hebeloma testaceum (Batsch: Fr.) Quél.	.	a2	.	.	.	.	.	.	.	.	1
	Lactarius deliciosus Fr.	.	n5	.	.	.	.	.	.	.	.	1
	Clavulina cinerea (Fr.) Schroeter	.	n3	.	.	.	.	.	.	.	.	1
	Russula veternosa Fr. s.s. Schaeff.	.	n3	.	.	.	.	.	.	.	.	1
	Inocybe geophylla (Sow.: Fr.) Kummer	.	r2	.	.	.	.	.	.	.	.	1
	Entoloma hirtipes (Schum.: Fr.) n.c. Moser	.	r1	.	.	.	.	.	.	.	.	1
	Melanoleuca strictipes (Karst.) Murr.	.	r1	.	.	.	.	.	.	.	.	1
	Russula pumila Rouzeau et Massart	.	r1	.	.	.	.	.	.	.	.	1
	Galerina sp.	.	.	r1	.	.	.	.	.	.	.	1
	Coprinus micaceus (Bull.: Fr.) Fr.	.	.	.	n1	.	.	.	.	.	.	1
	Psathyrella hydrophila (Bull.: Mérat) R. Maire	.	.	.	n1	.	.	.	.	.	.	1
	Lactarius vietus Fr.	.	.	.	r1	.	.	.	.	.	.	1
	Russula krombholtzii Schaeff.	.	.	.	r1	.	.	.	.	.	.	1
	Russula puellaris Fr.	.	.	.	r1	.	.	.	.	.	.	1
	Russula chameleontina Fr.	.	.	.	.	n3	.	.	.	.	.	1
	Russula olivascens (Pers.: Schw.) Bres.	.	.	.	.	r2	.	.	.	.	.	1
	Collybia fusipes (Bull.: Fr.) Quél.	.	.	.	.	r1	.	.	.	.	.	1
	Lepista nebularis (Fr.) Harmaja	.	.	.	.	r1	.	.	.	.	.	1
	Macrolepiota rhacodes (Vitt.) Singer	.	.	.	.	r1	.	.	.	.	.	1
	Xerocomus chrysenteron (Bull. ex St. Amans) Quél.	.	.	.	.	r1	.	.	.	.	.	1
	Russula mairei Singer	.	.	.	.	.	r1	.	.	.	.	1
	Hebeloma magnimamma (Fr.) Quél.	.	.	.	.	.	.	r1	.	.	.	1
	Cantharellus cibarius Fr.	.	.	.	.	.	.	.	n3	.	.	1
	Entoloma nidorosum (Fr.) Quél.	.	.	.	.	.	.	.	.	a5	.	1
	Galerina sp.	.	.	.	.	.	.	.	.	n5	.	1
	Clitocybe candicans (Pers.: Fr.) Kummer	.	.	.	.	.	.	.	.	n1	.	1
	Xerocomus subtomentosus (L.: Fr.) Quél.	.	.	.	.	.	.	.	.	r3	.	1
	Lepista inversa (Scop.: Fr.) Pat.	.	.	.	.	.	.	.	.	r2	.	1
	Inocybe napipes Lange	.	.	.	.	.	.	.	.	r1	.	1
	Lactarius helvus Fr.	.	.	.	.	.	.	.	.	r1	.	1
	Lactarius necator (Bull. emend. Pers.: Fr.) Karsten	.	.	.	.	.	.	.	.	r1	.	1
	Stropharia aeruginosa (Curt.: Fr.) Quél.	.	.	.	.	.	.	.	.	r1	.	1
	Stropharia inuncta (Curt.: Fr.) Quél.	.	.	.	.	.	.	.	.	r1	.	1
	Dermocybe semisanguinea (Fr.) Moser	.	.	.	.	.	.	.	.	.	a4	1
	Hebeloma mesophaeum (Pers.: Fr.) Quél.	.	.	.	.	.	.	.	.	.	a4	1
	Ramaria eumorpha (P. Karst.) Corner	.	.	.	.	.	.	.	.	.	r3	1
	Suillus luteus (L.: Fr.) S. F. Gray	.	.	.	.	.	.	.	.	.	r1	1

Litter decomposing fungi

Litter saprotrophs are strongly bound to the substrate they live on. Its presence is the most important factor limiting their occurrence. The type of phytocoenosis is of less importance; plant community provides suitable habitats. Some authors point out that phytocoenosis can affect this group of fungi by creating a special microclimate, e.g. humidity limiting litter decomposition (B u j a k i e w i c z, 1982; Ł a w r y n o w i c z, 1973; N e s p i a k, 1959). The infection of any substrate by a certain fungus may be dependent on the weather conditions, the presence of a certain animal or the occurrence of that fungus in its vicinity (L i s i e w s k a, 1992). The occurrence of litter saprotrophs can be influenced also by chemical properties of soil, particularly pH, as well as by chemical properties of litter and humus (T y l e r, 1989).

Litter inhabiting fungi are the least numerous ecological group in the reserve. In total 34 species were recorded in the plots. The main factor determining the number of species in this group was the amount of litter covering the forest floor and its diversity. The *Ap* association is an exception, where despite relatively homogeneous litter (mainly fir-needles), a great number of species inhabiting this substrate was found. In *VuP*, where litter is equally abundant and homogeneous (mainly pine needles), not even half of this number was present. The shady and humid floor of the natural young fir-forest creates much better microhabitats for fungi than relatively dry and light-exposed floor in the breeded young pine forest.

Among the litter inhabiting fungi four groups can be distinguished (Tab. 3):

A. U b i q u i t o u s s p e c i e s (20.5 %). In most cases they occurred abundantly and with high frequency, and are characterized by a broad ecological spectrum. *Mycena galopus*, *M. sanguinolenta*, *Collybia butyracea* var. *asema* and *C. peronata* are common in various types of forests. *Mycena zephirus* and *Clitocybe vibecina* are species favouring coniferous litter and they accompany coniferous trees. *Collybia cirrhata* inhabiting decaying sporocarps of *Russulales* was found almost everywhere where it could find suitable substrate. The lack of this species in plots II and III, where the fruitbodies of *Russula* were growing abundantly, is unaccountable.

B. S p e c i e s w i t h t h e c e n t r e o f o c c u r r e n c e i n t h e c o n i f e r o u s c o m m u n i t i e s (20.5 %). These are mainly species preferring coniferous litter as a substrate. They do not display any relationship with the type of plant community but depend on the presence of coniferous trees.

C. S p e c i e s w i t h t h e c e n t r e o f o c c u r r e n c e i n t h e d e c i d u o u s c o m m u n i t i e s (20.5 %). Most of them prefer deciduous litter. The similarity between plot IV and I is quite clear. This results probably from the similar stand composition and microhabitat conditions.

D. E x c l u s i v e s p e c i e s (38 %). It is difficult to draw any conclusions on their relationship with the phytocoenoses. In some cases they depend directly on the type of substrate, e.g. *Collybia cookei*, or on the habitat conditions, e.g. *Psathyrella* and *Corpinus* spp.

Table 3

Litter-decomposing fungi in the respective plots and forest communities
(For details see page 5-7)

Group	Association	TCss Ag	TCss Ag	TCss Aa	TCss Aa	TCt	Ap	QrP	QrP Aa	Qrp Aa	VuP	Spatial fre-
	No of plot	IV	V	II	III	I	VI	VII	VIII	IX	X	quen-
	Number of species	9	5	8	11	16	15	12	6	5	6	cy
A	*Mycena galopus* (Pers.: Fr.) Kummer	n2	n2	r1	a2	n3	a9	a2	a2	r1	n1	10
	Mycena zephirus (Fr.: Fr.) Kummer	.	.	a1	r1	n1	a3	a1	n1	a1	.	7
	Collybia cirrhata (Schum.: Fr.) Kummer	r1	.	.	.	n1	a3	n1	n1	a6	n1	7
	Mycena sanguinolenta (Alb. et Schw.: Fr.) Kummer	.	.	r1	r1	n1	a3	a2	.	r1	.	6
	Collybia butyracea v. *asema* (Fr.) Quél.	.	.	a1	a1	a4	.	a4	r1	.	.	5
	Clitocybe vibecina (Fr.) Quél.	n4	.	.	.	n1	.	.	.	n2	.	3
	Collybia peronata (Bolt.: Fr.) Singer	.	.	.	.	r1	.	.	r1	.	.	2
B	*Auriscalpium vulgare* S. F. Gray	.	.	r1	.	.	.	a4	.	.	.	2
	Clitocybe langei Sing. et Hora	.	.	.	r1	a1	a3	n2	.	.	.	4
	Lactarius camphoratus (Bull.: Fr.) Fr.	.	.	.	n3	.	r3	r1	.	.	.	3
	Collybia butyracea (Bull.: Fr.) Quél.	.	.	.	.	r3	n2	n2	.	.	.	3
	Mycena epipterygia (Scop.: Fr.) S. F. Gray	.	.	.	r1	.	.	n2	n1	.	.	3
	Marasmius androsaceus (L.: Fr.) Fr.	.	.	.	.	.	a2	.	.	.	a7	2
	Cortinarius hemitrichus Fr.	.	.	.	.	.	r2	.	.	.	a1	2
C	*Mycena aetites* (Fr.) Quél.	.	a1	a1	r2	.	.	a1	.	.	.	4
	Mycena tenella (Fr.) Quél.	.	.	n3	a1	r2	n2	.	.	.	.	4
	Collybia dryophila (Bull.: Fr.) Kummer	r1	.	.	a5	a2	r2	.	.	.	.	4
	Mycena chlorinella (Lge.) Singer	.	r1	.	.	r1	r1	.	.	.	.	3
	Lycoperdon molle Pers.: Pers.	r2	.	.	.	r2	.	.	.	.	.	2
	Lepista gilva (Pers.: Fr.) Roze	r1	.	.	.	r1	.	.	.	.	.	2
	Mycena stylobates (Pers.: Fr.) Kummer	r1	.	.	.	r1	.	.	.	.	.	2
D	*Psathyrella subcernua* (Schulz.) Singer	r1	.	.	.	.	.	.	.	.	.	1
	Rhodophyllus nitens (Vel.) Kühn et Romagn.	r1	.	.	.	.	.	.	.	.	.	1
	Psathyrella fatua (Fr.) Konr. et Maubl.	.	n1	.	.	.	.	.	.	.	.	1
	Psathyrella chondroderma (Berk. et Br.) A. H. Smith	.	r1	.	.	.	.	.	.	.	.	1
	Inocybe petiginosa (Fr.: Fr.) Gillet	.	.	n1	.	.	.	.	.	.	.	1
	Hemimycena delectabilis (Peck) Singer	.	.	.	r1	.	.	.	.	.	.	1
	Mycena polygramma (Bull.: Fr.) S. F. Gray	.	.	.	.	r1	.	.	.	.	.	1
	Clitocybe expallens (Pers.: Fr.) Kummer s.s. Bres.	.	.	.	.	.	r1	.	.	.	.	1
	Collybia cookei (Bres.) J. D. Arnold	.	.	.	.	.	r1	.	.	.	.	1
	Mycena metata (Fr.) Kummer	.	.	.	.	.	r1	.	.	.	.	1
	Mycena vitilis (Fr.) Quél.	.	.	.	.	.	.	r1	.	.	.	1
	Exobasidium vaccini (Fuck.) Woron.	.	.	.	.	.	.	.	.	.	a5	1
	Coltricia perennis (L.: Fr.) Murr.	.	.	.	.	.	.	.	.	.	r1	1

Lignicolous fungi

The occurrence of lignicolous fungi was limited by the presence of suitable substrate. They exploited either dead wood as saprophytes or usually injured or old specimens of living trees as parasites. After the death of the host they often decomposed its wood as saprotrophs, e.g. *Armillaria mellea, Heterobasidion annosum, Laetiporus sulphureus.* Most of lignicolous fungi prefered deciduous or coniferous wood.

There are several concepts concerning the status and classification of fungal communities on wood. P i r k and T ü x e n (1957), J a h n (1968), K r e i s e l (1961), R u n g e (1980) classified them as autonomic mycocoenoses. A r n o l d s (1981, 1988) and B a r k m a n (1973, 1987) regarded them as mycosocieties, whereas the term mycocoenosis is reserved to the complete assemblage of fungi growing within a certain biocoenosis. K o r n a ś (1957) described them as associated communities and considered as a category between synusiae and autonomic syntaxa. Fungi were also regarded as societies (synusiae) of the entire plant community (e.g. L i s i e w s k a, 1974; W o j e w o d a, 1975). The effect of phytocoenosis on this group of fungi is evident. However, the presence of substrate is much more important for the occurrence of lignicolous fungi than the forest association (T o r t i ć, 1985).

In the reserve, 94 lignicolous species were recorded in all plots (44 %). The number and species composition of these fungi depend on the stand composition, amount and variety of the substrate and on the humidity conditions of the plots and microhabitats. This is revealed by the configuration of the plots and communities in Table 4. At the one end of the range there are plots characterized by the lowest proportion of coniferous trees – *TCss Ag, TCt.* The central part includes *TCss Aa, Ap* (known for the great diversity of its mycoflora; there was also some birch-wood present here apart from the coniferous one), *QrP Aa* and *QrP.* At the other end where *VuP* is present the pine wood was practically the only possible substrate for lignicolous fungi.

Four groups of fungi inhabiting wood have been distinguished (Tab. 4):

A. U b i q u i t o u s s p e c i e s (26.5 %). Most of them are characterized by a broad ecological spectrum. They are associated with deciduous (e.g. *Bjerkandera adusta, Crepidotus variabilis, Stereum hirsutum, Trametes versicolor*) or coniferous wood (e.g. *Calocera viscosa, Tricholomopsis rutilans, Trichaptum abietinum*) or display hardly any edaphical preferences (*Hypholoma fasciculare, Dacrymyces stillatus, Mycena galericulata*). They belong to the most common species in Poland.

There are also some less common and/or substrate bound species in this group, such as: *Piptoporus betulinus, Nidularia farcta, Mycena purpureofusca, Panellus mitis* and *Paxillus panuoides.*

B. S p e c i e s o c c u r r i n g e x c l u s i v e l y i n t h e c o n i f e r o u s c o m m u n i t i e s (9.5 %). They strongly favour coniferous wood and are known to occur in coniferous and mixed forests. Only *Merulius tremellosus* shows a wider edaphical range and preference for birch wood.

Table 4

Lignicolous fungi in the respective plots and forest communities
(For details see page 5-7)

Group	Association	TCss Ag	TCss Ag	TCt	TCss Aa	TCss Aa	Ap	QrP Aa	QrP Aa	QrP	VuP	Spatial fre-
	No of plot	IV	V	I	III	II	VI	IX	VIII	VII	X	quen-
	Number of species	18	24	31	16	24	41	27	16	11	6	cy
A	*Hypholoma fasciculare* (Huds.: Fr.) Kummer	n3	.	n3	a3	.	a3	n2	a8	n6	r2	8
	Dacrymyces stillatus Nees.: Fr.	.	n1	n6	n7	n4	n4	n1	n4	n1	.	8
	Bjerkandera adusta (Willd.:Fr.)P.Karsten	a8	n2	a8	.	n1	a10	a9	a10	.	.	7
	Stereum hirsutum (Willd.: Fr.) S. F. Gray	.	r1	r1	r5	n5	n8	.	n6	.	.	6
	Trametes versicolor (L.: Fr.) Pilát	a10	n4	.	.	r2	.	r3	r4	.	.	5
	Mycena galericulata (Scop.: Fr.) S. F. Gray	.	r2	a6	n2	.	.	a5	.	r1	.	5
	Calocera viscosa (Pers.: Fr.) Fr.	.	.	.	n5	r1	n4	r2	r3	.	.	5
	Tricholomopsis rutilans (Schaeff.: Fr.) Singer	.	.	r1	r1	r2	.	.	.	r2	.	4
	Crepidotus variabilis (Pers.: Fr.) Kummer	r1	.	.	a3	.	.	.	.	a9	.	3
	Datronia mollis (Sommerf.: Fr.) Donk	.	r1	.	.	r2	r1	n2	.	.	.	4
	Piptoporus betulinus (Bull.: Fr.) P. Karsten	.	.	.	.	r9	.	r6	.	r5	.	3
	Fomes fomentarius (L.: Fr.) Fr.	.	.	n10	.	.	.	a10	.	.	.	2
	Trametes hirsuta (Wulf.: Fr.)Pilát	.	n1	.	.	.	.	r1	n6	.	.	3
	Nidularia farcta (Roth.: Pers.) Fr.	.	n2	.	.	.	.	r2	.	.	.	2
	Phlebia radiata Fr.	.	r1	.	.	.	r2	.	.	.	.	2
	Panellus mitis (Pers.: Fr.)Singer	.	.	r1	.	a1	a4	.	.	.	.	3
	Hyphoderma setigerum (Fr.) Donk	.	.	r1	.	r5	n6	.	.	.	.	3
	Armillaria mellea (Vahl. in Fl.D.: Fr.) Karst. (s.l.)	r1	.	.	.	r1	a2	.	a2	.	.	4
	Trichaptum abietinum (Pers.: Fr.) Ryv.	r1	.	.	.	r2	n5	.	.	.	.	3
	Mycena alcalina (Fr.) Kummer	r1	.	.	.	.	.	.	.	r1	.	2
	Mycena purpureofusca (Peck) Sacc.	r1	.	.	.	.	r1	.	.	.	.	2
	Hypholoma sublateritium (Fr.) Quél.	.	.	r3	.	.	n2	.	.	.	.	2
	Meruliopsis corium (Fr.) Ginns	.	.	.	r1	.	r1	.	.	.	.	2
	Postia stiptica (Pers.: Fr.) Jülich	.	.	.	.	r1	.	.	r1	.	.	2
	Paxillus panuoides Fr.	.	.	.	.	r1	.	.	r1	.	.	2
B	*Hypholoma capnoides* (Fr.: Fr.) Kummer	.	.	.	.	.	a3	.	r1	r2	n2	4
	Thelephora terrestris Pers.: Fr.	.	.	.	.	.	a8	.	n3	.	n1	3
	Gymnopilus penetrans (Fr.: Fr.) Murr.	.	.	.	.	.	n5	.	.	.	r1	2
	Stereum sanguinolentum (Alb. et Schw.: Fr.) Fr.	.	.	.	.	.	n5	.	.	n2	.	2

cont. Tab. 4

Group	Association	TCss Ag	TCss Ag	TCt	TCss Aa	TCss Aa	Ap	QrP Aa	QrP Aa	QrP	VuP	Spatial fre-
	No of plot	IV	V	I	III	II	VI	IX	VIII	VII	X	quen-
	Number of species	18	24	31	16	24	41	27	16	11	6	cy
	Gymnopilus hybridus (Fr. :Fr.) Singer	.	.	.	.	.	a6	a4	.	n7	.	3
	Merulius tremellosus Fr.	.	.	.	.	.	r3	a7	.	.	.	2
	Polyporus brumalis (Pers.): Fr.	.	.	.	.	.	r1	n2	.	.	.	2
	Schizophyllum commune Fr.	.	.	.	.	.	.	n6	n4	.	.	2
	Pholiota flammans (Fr.) Kummer	.	.	.	.	.	.	r1	.	r1	.	2
C	*Schizopora paradoxa* (Schrad.: Fr.) Donk	a5	n9	a10	a7	n6	a8	r1	.	.	.	7
	Pluteus atricapillus (Secr.) Singer	r1	r2	r2	r1	r1	r2	r1	.	.	.	7
	Postia caesia (Schrad.: Fr.) P. Karsten	n4	r2	r1	r4	r1	a6	.	.	.	.	6
	Exidia glandulosa Fr.	r1	r1	n5	.	r2	r1	r1	.	.	.	6
	Pluteus atromarginatus (Konr.) Kühner	r1	.	r1	.	.	.	r1	.	.	.	3
	Melanomma pulvis-pyrius (Pers.: Fr.) Fuckel	.	r1	r1	.	.	r1	.	.	.	.	3
	Peniophora cinerea (Pers.: Fr.) Cooke	.	r1	r1	.	.	r1	.	.	.	.	3
	Mycena rorida (Scop.: Fr.) Quél.	.	.	n1	.	.	r1	.	.	.	.	2
	Hypoxylon fragiforme (Pers.: Fr.) Kickx	r2	r1	.	.	n1	.	.	.	.	.	3
	Chondrostereum purpureum (Pers.: Fr.) Pouzar	.	.	n4	.	n7	.	.	.	.	.	2
	Stereum rugosum (Pers.: Fr.) Fr.	.	.	n10	.	n1	.	.	.	.	.	2
	Ganoderma applanatum (Pers.) Pat. (s.l.)	.	.	r10	n8	.	.	.	.	.	.	2
	Lycoperdon umbrinum Pers.: Pers.	.	.	r1	r1	.	.	.	.	.	.	2
	Phellinus hartigii (Allesch. et Schnabl.) Bond.	r10	.	.	r6	.	.	.	.	.	.	2
	Fomitopsis pinicola (Sw.: Fr.) P. Karsten	.	r1	.	r1	.	.	.	.	.	.	2
	Calocera cornea (Batsch: Fr.) Fr.	.	r3	r1	.	.	.	.	.	.	.	2
	Antrodiella hoehnelii (Bres. ex Höhn.) Niemelä	n1	n9	r1	.	.	.	.	.	.	.	3
D	*Mycena polygramma v. pumila* Lange	n2	.	.	.	.	.	.	.	.	.	1
	Xylaria hypoxylon (L.) Dumortier	r1	.	.	.	.	.	.	.	.	.	1
	Inonotus radiatus (Sow.: Fr.) P. Karsten	.	n5	.	.	.	.	.	.	.	.	1
	Daedaleopsis confragosa (Bolt.: Fr.) Schroeter	.	r1	.	.	.	.	.	.	.	.	1
	Daldinia concentrica (Bolt.: Fr.) Ces.	.	r1	.	.	.	.	.	.	.	.	1
	Hymenoscyphus epiphyllus (Pers.: Fr.) Rehm apud Kauf.	.	r1	.	.	.	.	.	.	.	.	1
	Hypoxylon multiforme (Fr.) Fr.	.	r1	.	.	.	.	.	.	.	.	1
	Crucibulum laeve (Huds.) Kambly	.	.	n1	.	.	.	.	.	.	.	1
	Hypoxylon fuscum (Pers.: Fr.) Fr.	.	.	r3	.	.	.	.	.	.	.	1

cont. Tab. 4

Sphaerobolus stellatus Tode: Pers.	.	.	r2	.	.	.	.	.	.	.	1
Lycoperdon nigrescens Pers.: Pers.	.	.	r1	.	.	.	.	.	.	.	1
Polyporus ciliatus (Fr.) Fr.	.	.	r1	.	.	.	.	.	.	.	1
Stropharia cyanea (Bolt. ex Secr.)Tuomikoski	.	.	r1	.	.	.	.	.	.	.	1
Tremella mesenterica Retz. in Hook.	.	.	r1	.	.	.	.	.	.	.	1
Pholiotina exannulata Kühner	.	.	.	a1	.	.	.	.	.	.	1
Phaeomarasmius erinaceus (Fr.) Kühner	.	.	.	.	n1	.	.	.	.	.	1
Cytosporina militaria Sacc.	.	.	.	.	r1	.	.	.	.	.	1
Grandinia nespori (Bres.) Cejp	.	.	.	.	r1	.	.	.	.	.	1
Lachnellula subtilissima (Cooke) Dennis	.	.	.	.	.	a10	.	.	.	.	1
Gymnopilus sapineus (Fr.) R. Maire	.	.	.	.	.	a6	.	.	.	.	1
Aleurodiscus amorphus (Fr.) Schroeter	.	.	.	.	.	n1	.	.	.	.	1
Scyntinostroma odoratum (Fr.) Donk	.	.	.	.	.	r4	.	.	.	.	1
Skeletocutis carneogrisea David	.	.	.	.	.	r4	.	.	.	.	1
Tremella encephala Pers.: Pers.	.	.	.	.	.	r3	.	.	.	.	1
Amylostereum chailletii (Pers.: Fr.) Boid.	.	.	.	.	.	r2	.	.	.	.	1
Heterobasidion annosum (Fr.) Bref.	.	.	.	.	.	r1	.	.	.	.	1
Mycena maculata Karsten	.	.	.	.	.	r1	.	.	.	.	1
Mycena rubromarginata (Fr.) Kummer	.	.	.	.	.	r1	.	.	.	.	1
Peniophora incarnata (Pers.: Fr.) P. Karsten	.	.	.	.	.	r1	.	.	.	.	1
Porpomyces mucidus (Pers.: Fr.) Jülich	.	.	.	.	.	r1	.	.	.	.	1
Steccherinum ochraceum (Pers. in Gmelin: Fr.) S. F. Gray	.	.	.	.	.	r1	.	.	.	.	1
Nectria cinnabarina (Tode: Fr.) Fr.	.	.	.	.	.	.	n1	.	.	.	1
Lactiporus sulphureus (Bull.: Fr.) Murr.	.	.	.	.	.	.	r2	.	.	.	1
Pholiota alnicola (Fr.) Singer	.	.	.	.	.	.	r2	.	.	.	1
Pholiota aurivella (Batsch: Fr.) Kummer	.	.	.	.	.	.	r2	.	.	.	1
Hapalopilus nidulans (Fr.) P. Karsten	.	.	.	.	.	.	r1	.	.	.	1
Mycena inclinata (Fr.) Quél.	.	.	.	.	.	.	r1	.	.	.	1
Lopharia spadicea (Pers.: Fr.) Boid.	.	.	.	.	.	.	r1	.	.	.	1
Panus conchatus (Bull.: Fr.) Fr.	.	.	.	.	.	.	.	a9	.	.	1
Auriculariopsis ampla (Lév.) R. Maire	.	.	.	.	.	.	.	r1	.	.	1
Leucostoma niveum (Pers.: Fr.) Höhnel	.	.	.	.	.	.	.	r1	.	.	1
Paxillus atrotomentosus (Batsch) Fr.	.	.	.	.	.	.	.	.	.	n5	1
Lentinus lepideus (Fr.: Fr.) Fr.	.	.	.	.	.	.	.	.	.	r1	1

All the species in this group, except for *Schizophyllum commune* and *Pholiota flammans*, were found, among others, in *Ap* and as a rule they attained high abundance and temporal frequency there. The fir-forest creates exceptionally favourable growth conditions for them.

C. Species occurring exclusively or with the centre of occurrence in the *TC* communities (18 %). This relatively abundant group mainly consist of species usually inhabiting deciduous wood. The exceptions are *Postia caesia* accompanying fir-trees and spruce, *Fomitopsis pinicola* growing on coniferous wood and *Phellinus hartigii* occurring on fir-wood.

D. Exclusive species (46 %). The great number of exclusive species growing on wood may indicate favourable living conditions for lignicolous fungi. The most abounding in this respect were plots I, VI and IX .

It may be assumed that the more specific the habitat conditions, plant community and its stand composition are, the more specific is the accompaning mycoflora in respect of the ecological preferences and range of occurrence of the species as well as the number of exclusive species (Fig. 3).

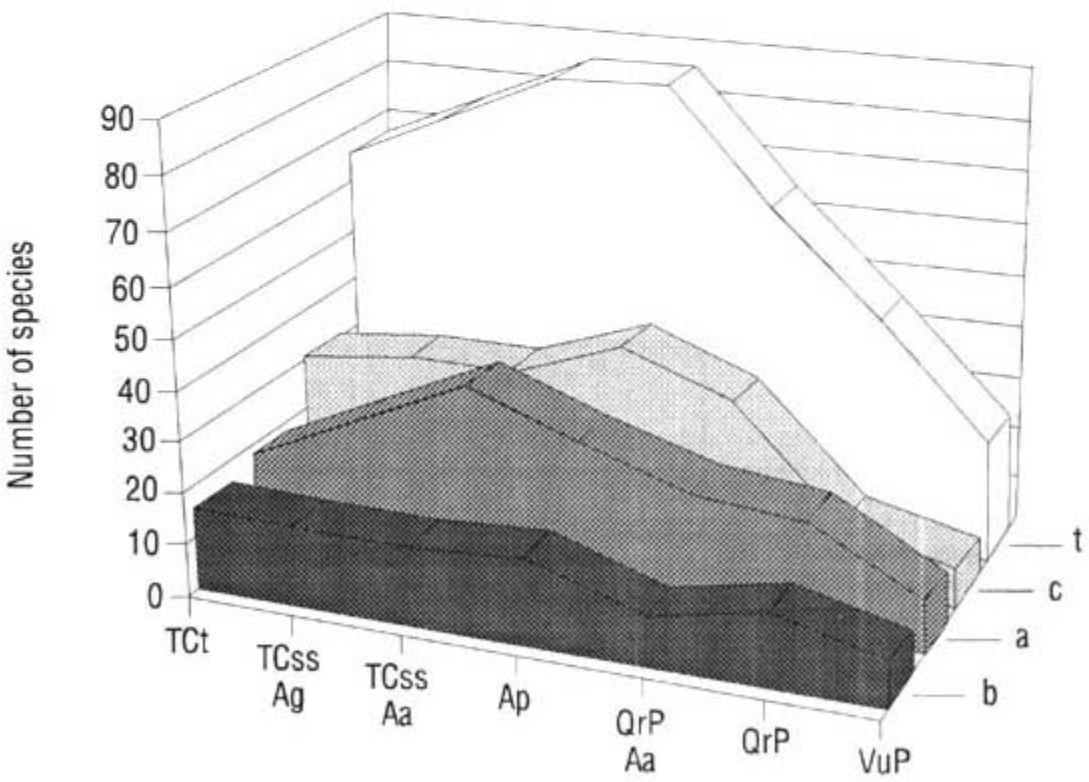

Fig. 3. Ecological groups of fungi in the respective forest communities
a – terrestrial fungi, b – litterr-decomposing fungi, c – lignicolous fungi, t – total
(For details see page 5-7)

THE RELATIONSHIP BETWEEN THE MYCOFLORA AND THE PRESENCE OF *ABIES*

The most interesting is the occurrence of three species, regarded as closely associated with fir-tree: *Aleurodiscus amorphus*, *Amylostereum chailletii* and *Phellinus hartigii*. These fungi are most often recorded in the mountains; in lowlands they are much more scanty and can be regarded as the montane element in mycoflora (L i s i e w s k a, 1992; W o j e w o d a, 1975). The first two species were found only in the patch of *Ap*. This community was described by B i g o s (1991) as an impoverished borderline variety of the association, in which the characteristic montane species are absent from the herb layer. The above-mentioned species may be considered as a kind of supplement to this characteristics.

In addition *Lachnellula subtilissima* and *Gymnopilus sapineus* were noted exclusively in the *Ap* community and most frequently on fir-wood. *Panellus mitis* grew on fir-branches; it occurred most frequently and with high abundance in *Ap*. According to L i s i e w s k a (1978) it is a characteristic species of the autumn aspect in *Ap* in the Świętokrzyski National Park. In the reserve *Trichaptum abietinum* and *Postia caesia* were the most frequently occurring species of fir-wood. Both of them attained the highest abundance and frequency in *Ap*. *Calocera viscosa* was noted exclusively in the communities with considerable proportion of fir-tree.

The present studies confirm the observations of fungi growing on fir-wood in communities with considerable proportion of *Abies* in the borderline localities (S a ł a t a, 1972, 1977, 1978). The following species occurred particularly abundantly on this type of substrate: *Aleurodiscus amorphus*, *Calocera viscosa*, *Dacrymyces stillatus*, *Lachnellula subtilissima*, *Panellus mitis* and *Trichaptum abietinum*. They accompany fir-trees fairly independently of the type of phytocoenosis.

In the group of litter decomposers *Mycena tenella* was particularly associated with the communities with *Abies*. *Marasmius androsaceus* grew abundantly and with high frequency on fir litter as well. In these communities *Cystoderma amiantinum*, *Russula ochroleuca*, *Xerocomus badius*, *Laccaria proxima*, *Russula fellea* and *Tylopilus felleus* – fungi characterized by broad ecological range – were recorded frequently. Fir does not seem to have specific mycorrhizal partners among macrofungi, although it forms mycorrhizae with micromycetes (K o w a l s k i, 1980; P a c h l e w s k i, 1955).

A comparative analysis of the macromycetes of *Ap* in the reserve and the macromycetes of the analogous associations in Central Roztocze (S a ł a t a, 1969, 1972), Jata forest reserve near Łuków (S a ł a t a, 1978) and in the Świętokrzyski National Park (L i s i e w s k a, 1978, 1979) shows a remarkable similarity of this community to *Ap* in Roztocze: the fungi typical of coniferous forests are predominant and they are accompanied by a considerable group of species occurring both in coniferous and deciduous forests. The fir-forest in the reserve has 44 species (51 %) in common with the same association in Central Roztocze. Among the species most

frequently recorded there S a ł a t a (1972) enumerated *Aleurodiscus amorphus, Amanita fulva, Calocera viscosa, Clitocybe clavipes, C. langei, Cystoderma amiantinum, Dacrymyces stillatus, Mycena zephirus, Panellus mitis, Russula ochroleuca, Xerocomus badius*. These species occurred in the reserve abundantly, with high temporal frequency or exclusively in *Ap* as well. The above community has also many species in common with *Ap* of the Jata forest reserve (S a ł a t a, 1978), e.g. *Aleurodiscus amorphus, Calocera viscosa, Cystoderma amiantinum, Dacrymyces stillatus, Lachnellula subtilissima, Mycena zephirus, Panellus mitis, Trichaptum abietinum, Tylopilus felleus*. The similarities are evident. However, they result mainly from the presence of lignicolous fungi which accompany *Abies* independently of the plant association, and the species having wide ecological spectrum. There are no species which might be considered as characteristic. Although they occur with high constancy in the *Ap* communities, they do not display fidelity at all. However, the species composition of fungi and their proportion may, to some extent, be regarded as typical for this association.

Mycoflora of the fir-forest in the reserve has also 26 species (30%) in common with *Ap* of the Świętokrzyski National Park (L i s i e w s k a, 1979) but in this case the similarity is much less pronounced. It is an open question whether the composition of macrofungi typical of *Ap* of the Jodły Łaskie and Jata reserves and of Roztocze is characteristic of this association in general or only of localities fairly close to the fir distribution limit.

B u j a k i e w i c z (1981, 1982), L i s i e w s k a (1978) and S a ł a t a (1972) found that the mycoflora of fir-forests and forests with considerable proportion of fir-trees is very rich and diverse. Inconsiderable effect of *Abies* on the species composition in oak-hornbeam forests was indicated by Ł a w r y n o w i c z (1973). In general, the fungi of fir-communities are characterized by fairly wide ecological range – these are mainly species occurring in coniferous woods and species of various types of forests.

SUMMARY OF THE RESULTS AND CONCLUSIONS

1. In the reserve area 231 taxa of macromycetes were recorded; 213 of them were found in the observation plots. The richest mycoflora was found in the *Ap* community, where 86 species were recorded; 85 species were found in *TCss Aa*, 75 in *TCss Ag*, 65 in *TCt*, 64 in *QrP Aa*, 44 in *QrP* and 22 in *VuP*.

2. The species recorded in the observation plots were analysed in 3 ecological groups, according to the type of inhabited substrate: terrestrial fungi (85 species, 40 %), litter-decomposing fungi (34 species, 16 %) and lignicolous fungi (94 species, 44 %).

3. It was recognized that terrestrial fungi were associated the most with a given phytocenosis. Most of them were characterized by a distinct dependence on the composition of the stand. The species composition of terrestrial mycoflora depended also on the character of phytocoenosis and its specificity. Highly distinguishable, specific phytocoenoses had a higher percentage of exclusive species and fungi characterized by a narrow ecological range. The fungi associated mainly with coniferous communities were characterized by a broader ecological spectrum than the fungi occurring mainly in the deciduous patches.

Amongst the fungi growing on the ground *Russula* (19) and *Lactarius* (12) species prevailed. The richest in terrestrial fungi was the patch of *Ap* (41), the poorest – the patch of *VuP* (10).

4. Litter decomposing fungi were strongly bound to the inhabited substrate. The factor decisive for the number of these species was the amount of litter covering the forest floor and its diversity. The type of plant community was of minor importance; phytocenosis supplies the favourable substrate and creates specific microclimate determining litter decomposition. The distribution of these fungi in respective types of phytocoenoses was determined most frequently by their edaphical preferences and the composition of litter.

The highest number of species from this group was recorded in *TCt* (16), the lowest – in the more humid patches of *TCss Ag* and *QrP* Aa (5). Amongst the fungi growing on litter *Mycena* spp. were predominant.

5. The species composition of lignicolous fungi and their number depended on the amount and diversity of substrate and on the humidity conditions of patches and microhabitats. The type of phytocoenosis was of less importance. Plant community affected these fungi mainly through the composition of tree-stand, namely the type of substrate provided, and through the specific microclimate created by each phytocoenosis (e.g. certain humidity level). A great majority of lignicolous fungi displayed edaphical preferences towards deciduous or coniferous wood.

The richest in fungi growing on wood was *Ap* (41), the poorest – *VuP* (6).

6. Fungi as an integral part of biocoenosis have some indicator value and may be considered in the phytosociological analysis of plant communities. The quantitative and qualitative analysis of the mycoflora in the fir-forest reveals its affiliation to *Ap* in other localities close to the fir distribution limit.

7. In the reserve area 3 species of fungi strongly bound to fir-tree were recorded: *Aleurodiscus amorphus*, *Amylostereum chailletii* and *Phellinus hartigii*. They may be regarded as the montane elements in the mycoflora.

The mycoflora of the communities, where *Abies* occurrs abundantly, is rich and diverse; however, it is not specific. Most fungi display fairly broad ecological range; they are mainly associated with coniferous and various types of forests.

8. Many interesting and rare fungi were found. In addition to herbaceous plants which are strictly or partially protected by law and valuable specimens of trees, they contribute to the high natural value of the reserve.

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Macromycetes zbiorowisk leśnych rezerwatu Jodły Łaskie (Polska Środkowa)

S t r e s z c z e n i e

Badania obejmują lata 1989, 1990 i 1992. Regularne obserwacje na 10 stałych powierzchniach (400 m^2) prowadzono w sezonie 1990 w płatach reprezentujących zespoły: *Tilio-Carpinetum, Abietetum polonicum, Querco roboris-Pinetum* i *Vaccinio uliginosi-Pinetum* uwzględniając ich zróżnicowanie na podzespoły i warianty. Ogółem zanotowano 231 taksonów macromycetes, w tym 213 na powierzchniach obserwacyjnych.

Stwierdzono duży wpływ na skład gatunkowy grupy grzybów naziemnych charakteru fitocenozy i warunków siedliskowych. Im bardziej specyficzna fitocenoza, skład drzewostanu, warunki glebowe i wilgotnościowe, tym bardziej specyficzna jest towarzysząca im mikoflora, zarówno pod względem preferencji ekologicznych jak i liczby gatunków wyłącznych. Grzyby naściółkowe wykazywały silny związek z substratem, na którym występują. Typ zbiorowiska roślinnego odgrywa w tym wypadku mniejszą rolę, polegającą na dostarczaniu odpowiedniego podłoża i tworzeniu specyficznego mikroklimatu, warunkującego rozkład ściółki. Czynnikiem decydującym o rozmieszczeniu i liczbie gatunków tej grupy jest głównie ilość zalegającej dno lasu ściółki, jej skład i zróżnicowanie. Liczba i skład gatunkowy grzybów nadrzewnych zależą od ilości i różnorodności substratu, składu drzewostanu oraz od wilgotności płatów i mikrosiedlisk.

Przeprowadzone obserwacje potwierdzają wartość wskaźnikową pewnych gatunków grzybów, która może mieć znaczenie pomocnicze w analizie fitosocjologicznej.

Nieco na północ od rezerwatu przebiega granica zasięgu jodły w Polsce Środkowej, szczególną więc uwagę poświęcono mikoflorze boru jodłowego *Abietetum polonicum*. Jest ona bardzo bogata i różnorodna, jakkolwiek mało specyficzna. Składa się głównie z gatunków borowych i gatunków różnych typów lasu oraz odpowiada mikoflorze boru jodłowego opisanego z Roztocza.

Na uwagę zasługuje obecność *Aleurodiscus amorphus, Amylostereum chailletii* i *Phellinus hartigii*, gatunków ściśle związanych z jodłą, stanowiących element górski w mikoflorze rezerwatu.