ACTA MYCOLOGICA
Vol. XXVII (1): 137-158
1991-1992

Higher fungi of the Tilio-Carpinetum forest association in the Skołczanka Reserve near Cracow

BARBARA GUMIŃSKA

Institute of Botany of the Jagiellonian University, Department of Plant Taxonomy and Phytogeography, Lubicz 46, 31-512 Kraków, Poland

G u m i ń s k a B.: *Higher fungi of the Tilio-Carpinetum forest association in the Skołczanka Reserve near Cracow*. Acta Mycologica XXVII (1): 137-158, 1991-1992.

The paper presents the current state of the higher fungi in *Tilio-Carpinetum* forest association in the Skołczanka Reserve near Cracow. The resulst of some ecological observations are also given.

INTRODUCTION

Mycological researches were carried out in deciduous forest in the Skołczanka Reserve near Cracow (Southern Poland) in 1988-1990. The Reserve covers on area of 36.5 ha and is situated on limestone hills. This region represents some variety with respect to plant communities it is covered by deciduous and coniferous forests (partially planted) as well as by non-woody grasslands (D z w o n k o, L o s t e r, 1990). Deciduous forests are situated mainly in the southern parts of the Reserve and are represented by *Tilio-Carpinetum* association distinguished by T r a c z y k (1962) and M e d w e c k a - K o r n a ś and K o r n a ś (1963): assoc. *Tilio-Carpinetum* Tracz., alliance: *Carpinion betuli* Oberd., order: *Fagetalia sylvaticae* Pawł., class. *Querco-Fagetea* Br.-Bl.

METHODS

In the Sokołczanka Reserve *Tilio-Carpinetum* association covers an area of 18.22 ha. In this forest mycological investigations were carried out in two stages.

F i r s t s t a g e (from 1988). All speciments of higher fungi were collected and determined during the frequent forays throughout the period fructification in 1988--1989. For each species the type of substrate which it occured on was noted. On the

grounds of these data some ecological groups have been distinguished. Fairy rings which occured sometimes in the form of very regular circles or arches with numerous sporocarps were also observed.

S e c o n d s t a g e (in 1990). Special attention was paid to the seasonal fluctuations of the fungus flora during the period of fructification i.e. May-November. The number of species occuring in the forest was noted in fortnightly intervals. The time of the peak of the fructification period was recorded and then interpreted against a background of amount of precipitation in this year. Meteorogical data were recorded from the Station about 3.5 km north-west of the Skołczanka Reserve: Inst. Meteor. Gosp. Wod. (Kraków – Tyniec).

T a b l e 1

Monthly precipitation in IV-XI 1990 from Meteorological Station in Tyniec

Months	IV		V		VI		VII		VIII		IX		X		XI	
fortnightly intervals	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
mm/2 weeks	41.3	27.8	9.4	45.7	31.3	24.2	48.6	2.2	76.6	78.5	69.6	39.9	3.2	15.8	25.6	44.4
mm /month	69.1		55.1		55.5		50.8		155.1		109.5		19.0		70.0	

In addition, the abundance of fructification of particular species during each foray was noted and designated after shortening and a some modifying the scale given by A r n o l d s (1981): 1 – rare, 2 – uncommon (sporadic), 3 – fairly common, 4 – common.

In the Skołczanka Reserve no close mycological investigations were carried out hitherto. Only fragmentary data can be found in the unpublished thesis of B a ł a n d a (1987).

The nomenclature of species mentioned in the paper has been adopted from well known publications (B r e i t e n b a c h, K r ä n z l i n, 1984; J ü l i c h, 1984; M i c h a e l, H e n n i g, K r e i s e l, 1983; S k i r g i e ł ł o, 1991; W o j e w o d a, 1981). The dry collection of gathered fungi has been deposited in the herbarium of the Institute of Botany of the Jagiellonian University.

RESULTS

ANALYSIS OF THE FLORA OF HIGHER FUNGI

G e n e r a l r e m a r k s. In the course of investigations (1988-1990) the moderate fungus crops were recorded in the *Tilio-Carpinetum* association. The highest number of sporocarps was observed in the southern par : of the forest, along

the track to the village of Podgórki. These parts of the forest were situated on an almost flat ground with the litter usually quite moist due to the rain-water flow from the southern hills. The upper parts of the hills were more dry and scanty with fungi. In these places the litter layer was very thin and as results the following species were not appear: *Clitocybe clavipes, C. odora, Mycena epipterygia, Oudemansiella longipes*, which prefer thick and rich litter.

Some mushrooms fructified only in isolated places in the forest where the tree conopy was loose. There, we could find for instance: *Entoloma sericeum*, *Psathyrella corrugis* and *P. subatrata.*

Number of species. The total list of fungi found in the course of observations includes 159 taxa: 92 – *Agaricales*, 20 – *Aphyllophorales*, 19 – *Russulales*, 9 – *Ascomycetes*, 7 – *Lycoperdales*, 4 – *Boletales*, 4 – *Tremellales*, 2 – *Nidulariales*, 1 – *Sclerodermatales* and 1 – *Phallales*. This is not a complete list of species which could be found in the studied forest. Due to the ephemeral character of the life of fungi some species could be present in one year and absent in the following – they could appear again even after an interval lasting many years.

There are 78 genera with a total number of 159 species of fungi. The number of species within particular genera ranges from 1 to 11 but only 13 genera had 4 or more representatives in the Skołczanka Reserve; 65 genera were represented by a few (1-3) species. The genera richest in species were: *Russula* – 11 species (in Europe ± 160), *Mycena* – 9 sp. (in Eur. ± 100) and *Lactarius* – 8 sp. (in Eur. ± 80); (Fig. 1).

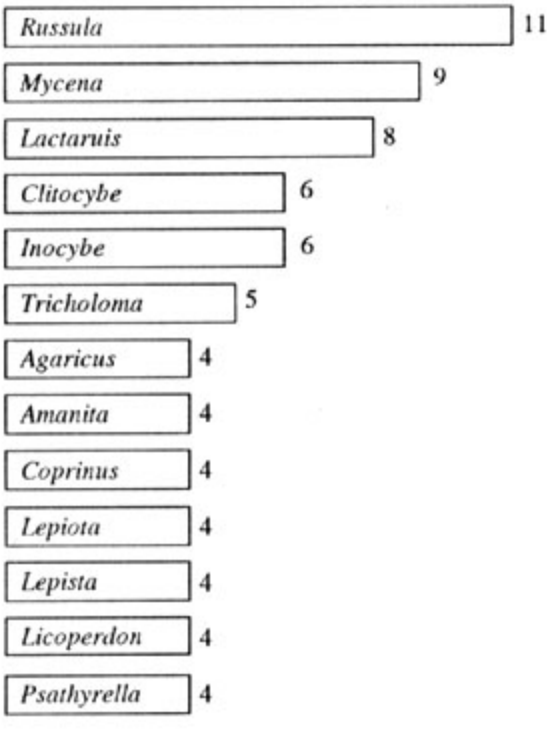

Fig. 1. The most numerous genera of cap-fungi in *Tilio-Carpinetum* in Skołczanka Reserve (number of species without particular genera are given next to the bars)

It is remarcable that only 4 species of *Boletales* among the fungi growing in the Sokołczanka Reserve were found, namely: *Chalciporus piperatus*, *Leccinum scabrum*, *Paxilus involutus* and *Xerocomus chrysenteron*. All species mentioned above (except for the rather common *Xerocomus chrysenteron*) were found rarely and only a few specimens were noted.

Relations to limestone. The Skołczanka Reserve is situated on the hills composed of Jurassic limestones. Mycoflora of this region consists of species tolerating well the lime in the soil, but in fact no typical calciphilous species like *Catathelasma imperiale* or *Hygrophorus penarius* were found. The following species which grow in the Reserve, and prefered that type of substratum were noted: *Clitocybe inornata*, *Lactarius aspideus* var. *flavidus*, *Lycoperdon echinatum*, *Oudemansiella longipes*, *Russula alutacea* and *R. rosacea*. On the other hand *Lactarius necator* which was common in the Reserve has preference for the acid soil (Michael, Hennig, Kreisel, 1983; Moser, 1983; Neuhoff, 1956).

Relations to type of forest. Almost all fungi occuring in *Tilio-Carpinetum* in the Reserve may be included among the species which are associated with deciduous forests. Nevertheless some the recorded fungi occur more often in a coniferous than in a deciduous forest – for instance: *Agaricus semotus*, *A. silvaticus*, *Chalciporus piperatus*, *Cystoderma amianthinum*, *Inocybe mixtilis*, *Lactarius mitissimus*, *Limacella illinita*, *Pholiota flammans* and *Scleroderma citrinum*. In the studied forest their occurance may be due to the presence of *Pinus sylvestris*. Some of the mentioned fungi may exist in a mycorrhizal symbiosis with this tree.

Poisonous fungi. The number of poisonous mushrooms in *Tilio-Carpinetum* in the Reserve was not too high. The slightly poisonous included: *Hypholoma fasciculare*, *Russula fragilis* and *Tricholoma sulphureum*; the fairly poisonous included: *Amanita citrina*, *A. muscaria* and *Scleroderma citrinum*. Strongly poisonous mushroom *Amanita phalloides* was fairly common throughout the forest. It often occured gregariously in several specimens.

Formation of fairy rings. In the course of observations the occurence of fairy rings was observed. Six species occured in distinct circles or arches: *Agaricus silvaticus*, *Ramaria eumorpha*, *Lepista gilva*, *L. irina*, *L. nebularis* and *L. nuda*. Especially the species from the genus *Lepista* formed big rings, consisting of many specimens. The diameters of these rings varied from 1.8 to 10.0 metres. The number of fruit bodies in paricular rings or arches varied from 16 to 172 (some exemples – Fig. 2).

Lepista gilva:

a) broad elipse 3.6 x 3.2 m in diameters composed of 57 fruit bodies; inside – 2 living beech-trees and 3 dead trunks; observations from 23.IX.1989 (Fig. 2 A).
b) regular ring 3.0 m in diameter composed of 99 fruit bodies; inside – no tree or trunk; observations from 3.X.1989 (Fig. 2 B).

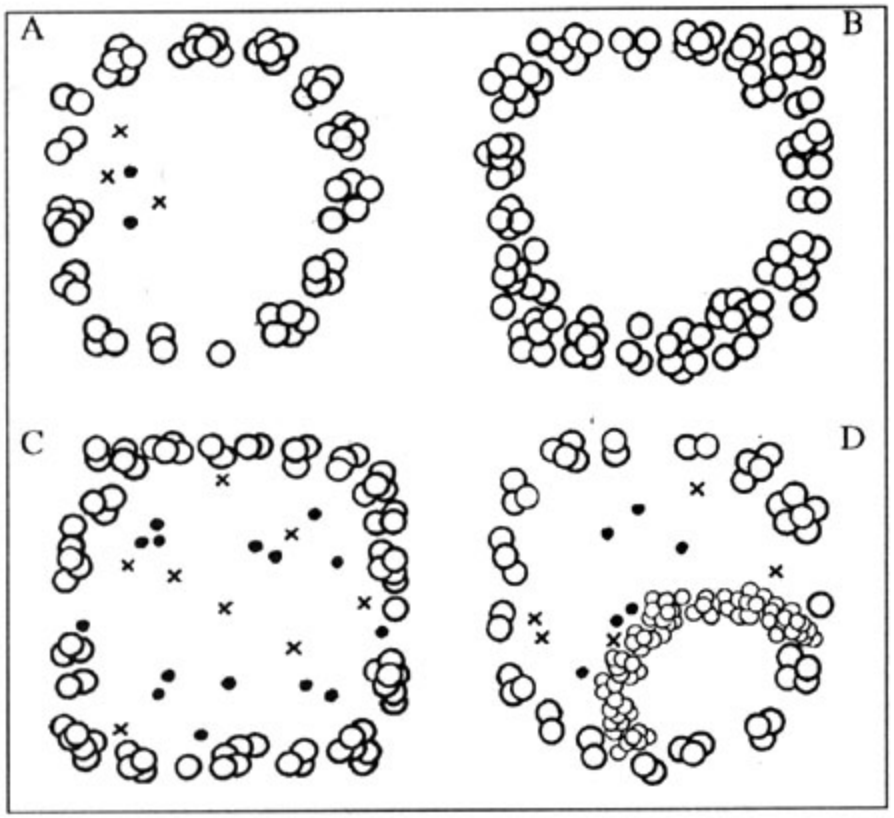

Fig. 2. Some examples of fairy rings found in *Tilio-Carpinetum* in the Skołczanka Reserve in 1989-1990
A, B – *Lepista gilva*, C, D – *Lepista nebularis*; circle – fruit bodies, point – living trees, cross – dead trunks

Lepista nebularis:

a) regular ring 10.0 m in diameter composed of 77 fruit bodies; inside – 13 living beech-trees, 1 birch and 8 dead trunks (one of them, especially the big trunk was situated in the very centre of the ring); the observations from 19.IX.1989 (Fig. 2 C).

b) regular ring 10.0 m in diameter composed of 46 fruit bodies; inside – 4 living beech-trees, 2 hornbeam and 5 dead trunks; in the lower part of the ring a semi-ring 5.6 m in diameter composed of 66 fruit bodies of *Lepista gilva* was recorded; observations from 23.IX.1989 (Fig. 2 D).

c) regular ring 8.5 m in diameter composed of 172 fruit bodies inside – 5 beach trees, 1 birch and 2 dead trunks; observations from 11.IX.1990.

Lepista nuda:

a) ellipse 2.2 x 1.3 m in diameter composed of 16 fruit bodies; inside – no tree or trunk; observation from 25.X.1989.

b) 3/4 of the ring 1.8 m in diameter composed of 49 fruit bodies; inside – no tree or trank; observations from 25.X.1989.

Lepista irina:

regular ring 2.0 m in diameter composed of 24 fruit bodies; inside – any tree or trunk; observations from 3.X.1989.

C o n c l u s i o n s. After 3-years of observations it may be concluded that the following (10) species could be considered as locally characteristic the *Tilio-Carpinetum* association in the Skołczanka Reserve:

Collybia dryophila	*Lepista nebularis*
Hygrophorus eburneus	*Lycoperdon perlatum*
Lactarius necator	*Mycena pura*
Lactarius quietus	*Oudemansiella radicata*
Lepista gilva	*Tricholoma sulphureum*

Each year, the species listed above occured in great abundance. Some of them varied either the variability in colours or in the size of the pileus, i.e.:

- the colour of fruit bodies of *Mycena pura* (which occured in places in great numbers) ranged from pure white or pale pink to dark lilac-pink,
- the dimension of pileus of *Oudemansiella radicata* ranged from 2.5 cm to 12 cm.

In the studied forest the following interesting and rare species occuring in Poland were found:

Geastrum sessile	*Lycoperdon echinatum*
Geastrum vulgatum	**Macrotyphula juncea*
**Hydropus subalpina*	*Oudemansiella longipes*
Lactarius aspideus var. *flavidus*	**Pluteus romellii*
**Lactarius vellereus* var. *velutinus*	**Psathyrella corrugis*
Lepiota ignivolvata	*Psathyrella subatrata*
**Lepiota pseudohelveola*	**Russula violeipes*
**Limacella illinita*	

Some of this species mentioned above fructified sporadically in *Tilio-Carpinetum* association, but others occured only once during the 3 years. These species are marked with an asterisk.

SEASONAL FLUCTUATIONS OF THE FUNGUS FLORA

The seasonal changes of the fungi in the *Tilio-Carpinetum* were observed at fortnightly intervals throughtout the period of fruiting from May to November 1990. The changes in the number of fungi fructifying during the year depend on the wether conditions. Rainfalls and temperature are the most important factors. The total precipitation (IV-XI 1990) amounted to 584.1 mm. The monthly precipitation is presented in Table 1.

S e a s o n a l c h a n g e s (in 1990). In the Skołczanka Reserve the beginning of the fruitication period in *Tilio-Carpinetum* did not start before the first part of May (Fig. 3). The fungi found earlier were: a – perennial fruit bodies on fallen twigs (some *Sphaeriales*, *Tremellales*, some *Aphyllophorales*), b – dry fruit bodies of puff-balls (some from *Lycoperdales*) which had fructified in the autumn of last year and stayed under snow through the winter. Dry specimens of puff-balls were latter

found in the litter, even in the first part of July, while the first fresh ones appeared only in the early part of August.

In June the number of species increased (up to 11), and in July – up to 22 and then decreased again to 11 in the first part of August. The serious drought in the second part of July caused a reduction in the number of species. From the 14th of July to the 5th of August the precipitation only amounted to 2.2 mm. The fungi started to appear in greater numbers only in the second part of August, especially after the rain storm on the 16th of August – the rainfall was about 36.1 mm. That is why in the second part of August already 35 species of the fungi had fructified.

The peak of the fructification period fell in the second part of September (76 species) in spite of low temperatures at that time. It is interesting that the number of species was nearly the same (52 and 53 species) respectively in the first part of September and in the first part of October (Fig. 3). In the second part of October the number of species rapidly decreased due to the longer dry period: from the 1st to the 26th of October the precipitation amounted to 3.7 mm. The fruit bodies of fungi stopped developing in the first part of November. At this time the first snow usually fell and the first frosts were observed (just as in 1989). Low temperatures seem to be the limiting factor in the late autumn.

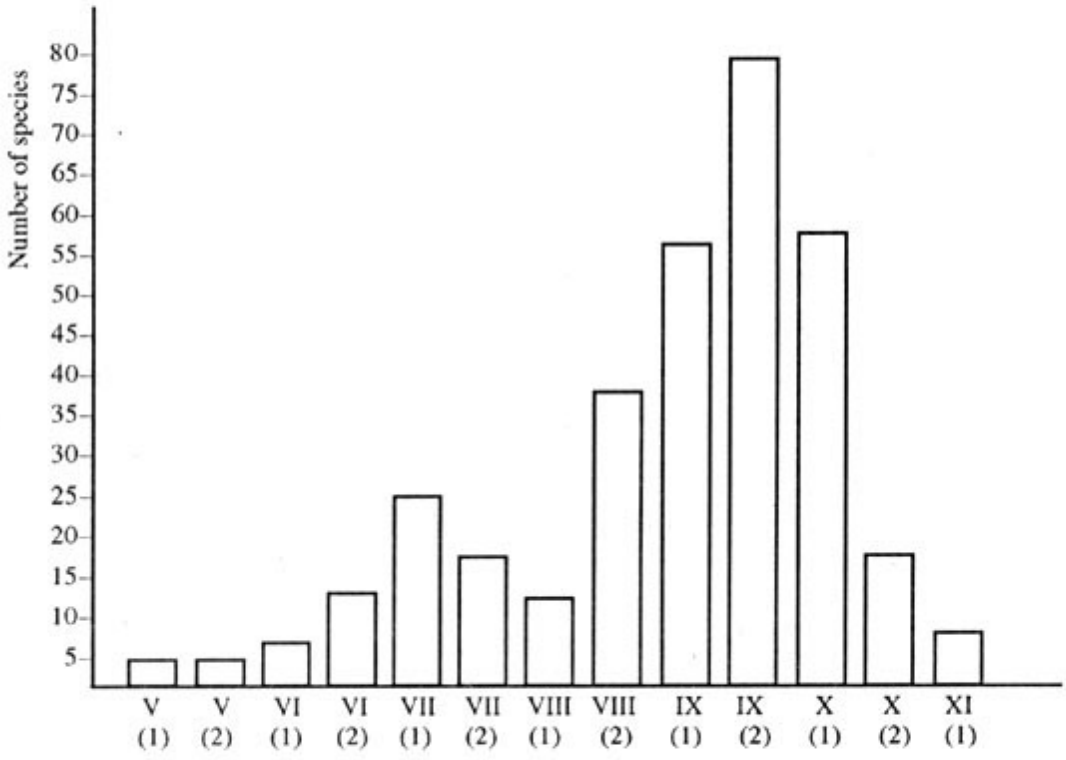

Fig. 3. Number of species of terrestial fungi developing fruit bodies in *Tilio-Carpinetum* in Skołczanka Reserve in 1990 – in brackets first part (1) and second part (2) of the month

Rhythm of fructification. Attention should be paid to the rhythm of fructification of some common species from the studied forest.Particular species reacted differently under the same conditions, so we may distinguish some types of the rhythm of their fructification (Fig. 4):

a – some species had a long (even several months) period of fructification: from May (*Mycena pura*), from to June (*Lepista gilva*) or from July (*Collybia dryophila*) to the end of October or even November (Fig. 4 A, C);

b – the following species which occured in the second part of August or in the first part of September and were found in second part of October and characterised on a shorter period of fructification: *Hygrophorus eburneus*, *Lactarius necator*, *L. quietus* and *Tricholoma sulphureum* (Fig. 4 B, D).

Time of fructification of some rare or uncommon species in the Reserve varied. It lasted for a more or less short time i.e.:

– only for 4 weeks: *Lactarius pireratus* (in July), *Russula fragilis* and *Tricholoma scalpturatum* (from the mid of September to the mid October);

– only for 2 weeks: *Tarzetta cupularis* (from the end of June to the beginning of July), *Oudemansiella longipes* (from the end of August to the beginning of September), *Amanita citrina* (from the end of September to the beginning of October);

– only for 1 week: *Inocybe mixtilis* (in the first part of July), *Russula violeipes* (in the latter half of July), *Psathyrella corrugis* (in the second part of August – some ephemeral species fructified only for 2-3 days: *Psathyrella subatrata* (in the latter part of August), *Macrotyphula juncea*, *Otidea onotica* and *O. umbrina* (in the second part of September), *Limacella illinita* (in the first part of October).

The rhythm of fructification was not always continuous – it was interrupted by two (or even three) periods of fructification, sometimes different with respect to the abundance of fruit bodies. In the Skołczanka Reserve some terricolous and lignicolous species fructified at two different periods in 1990 e.g.: *Amanita rubescens*, *Hypholoma fasciculare*, *Lepiota ignivolvata*, *Lepista irina*, *L. nebularis* (Fig. 4 B), *Marasmius ramealis* and *Mycena sanguinolenta* (Table 2).

Table 2

The two periods of fructification of some fungi in *Tilio-Carpinetum* in 1990

Species	First period of fructification	Second period of fructification
Hypholoma fasciculare	2.V - 19.V	29.VIII - 25.X
Marasmiellus ramealis *Mycena sanguinolenta*	27.VI - 7.VII	11.IX - 25.IX
Lepista irina	27.VI - 7.VII	11.X - 20.X
Amanita rubescens	24.VII - 31.VII	11.IX - 25.IX
Lepiota iquivolvata	31.VII - 8.VIII	19.IX - 11.X

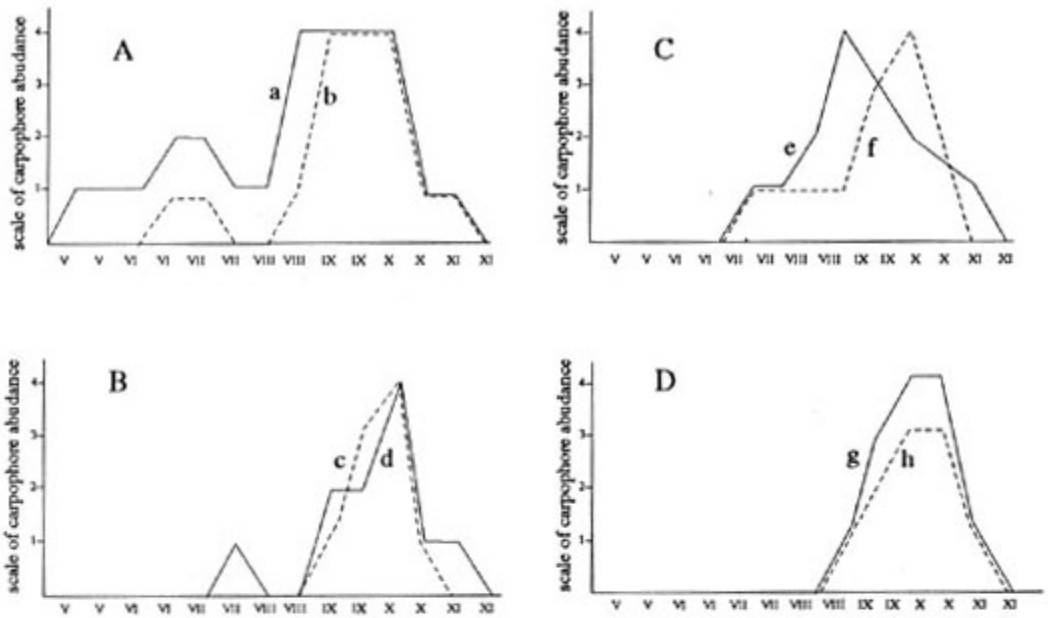

Fig. 4. Rhythm of fructification of some dominant species of group of terrestial fungi during the vegetative season in 1990 (fortnightly itervals in each month are given)

Scale of fruit bodies abundance in each fortnight: 1 – rare, 2 – uncommon (sporadic), 3 – fairly common, 4 – common. A: a – *Mycena pura*, b – *Lepista gilva*; B: c – *Lactarius necator* and *Hygrophorus eburneus*, d – *Lepista nebularis*; C: e – *Collybia dryophila*, f – *Ramaria eumorpha*; D: g – *Tricholoma sulphureum*, h – *Lactarius quietus*

C o n c l u s i o n s. The reported data on seasonal changes of the fungus flora in the studied forest are barely sufficient to describe the general course of fructification during over a period of many years. The number of species and the abundance of fructification may fluctuate in various years. The species may also differ in particular years. It is expected that only common species will occur every year, althought the abundance many very.The presented data should be considered as a contribution to the knowledge of phenological changes of mycoflora in oak-hornbeam forests.

ECOLOGICAL GROUPS

D e s i g n a t i o n s o f g r o u p s. For the ecological interpretation of higher fungi found in *Tilio-Carpinetum* asociation in Skołczanka Reserve all species were assigned to one of the 4 following ecological groups:

1 – saprophytic terrestrial species growing on soil, in litter, on fallen leaves and between mosses;
2 – saprophytic lignicolous species growing on stumps, fallen branches, little twigs and woody remnants lying in the litter;
3 – facultative parasitic species growing on woody substrates;
4 – mycorrhizal species.

From among the 159 species found in *Tilio-Carpinetum* in 1988-1990 each of the above mentioned groups includes:

– 59 terrestrial saprophytic species
– 45 lignicolous saprophytic species
– 5 facultative parasitic species
– 50 mycorrhizal species

The proportions of these 4 groups may fluctuate in various years due to the ephemeral character of fruit bodies.

Terrestrial saprophytes. This group comprises the greatest number of species (59). The following typical fungi growing on litter and humus, among fallen leaves and plant remains belonging to this group: *Clitocybe hydrogramma, C. inornata, C. odora, Collybia dryophila, Lepiota clypeolaria, Lepista nebularis, Oudemansiella longipes* and others. Some species were found growing directly on the surface of wet leaves lying in the litter e.g.: *Clitocybe candicans, Collybia peronata, Marasmius cohaerens, Mycena stylobates* and others. A few fungi grew on bare soil without any litter (*Humaria hemisphaerica, Tarzetta cupularis*) or between mosses (*Rickenella fibula*).

Among the terrestrial saprophytes *Agaricales* was the most numerous group with 45 species (Table 3). Species from the following genera which were noted in the studied forest belonged to this group: *Agaricus, Clitocybe, Collybia, Lepiota* and *Macrolepiota*. Other taxonomical groups were not so numerous: *Gasteromycetes* (i.e. *Sclerodelmatales, Nidulariales, Lycoperdales* and *Phallales*) only 7 species, *Ascomycetes* – 4 species (*Pezizales*). *Aphyllophorales* (the smallest group) comprised only 3 species from the terrestrial saprophyte group: *Clavulina cinerea, C. cristata* and *Macrotyphula juncea*. The apperance of fruit bodies of the latter in the second part of September 1990 was highly interesting. This species appeared only once during the 3-years observations. The fructification lasted only a few days and was very abundant: thausands fruit bodies grew on the surface of the leaves laying in the litter in the forest.

Table 3

Number of species of various taxonomic groups within particular ecological groups

Ecological groups / Taxonomic groups	S	L	M	P
Agaricales	45	22	24	1
Aphyllophorales	3	12	2	3
Gasteromycetes	7	3	1	–
Ascomycetes	4	4	–	1
Tremellales	–	4	–	–
Russulales	–	–	19	–
Boletales	–	–	4	–
Total	59	45	50	5

S – terrestial saprophyte, L – lignicolous saprophyte, M – mycorrhizal species, P – facultat e parasite

The boundary between terrestrial saprophytes and mycorrhizal fungi is not sharp. Some ectomycorrhizal species could occasionally occur as saprophytes e.g. *Laccaria laccata* or *Paxillus involutus* (Arnolds, 1989).

Lignicolous saprophytes. Wood inhabiting fungi also formed a large group (45 species). They have been identified on dead wood varying such as trunks to branches or small twigs. The following species occured on dead trunks: *Ganoderma lipsiense, Hypholoma fasciculare, H. sublateritium, Pluteus atricapillus, Pseudohydnum gelatinosum, Tricholomopsis rutilans* and others. The following species were found often thicker branches lying on the soil: *Daedaleopsis confragosa, Trametes hirsuta, T. versicolor* and others. The following species were found on small twigs or woody remnants: *Crepidotus variabilis, Marasmiellus ramealis, Marasmius rotu' ·. Merulius tremellosus, Psylocybe crobula, Schizopora paradoxa, Steccherinum ochraceum* and others. Among the lignicolous saprophytes *Agaricales* was the most numerous group with 22 species (Table 3). All species from the genus *Hypholoma* and *Pluteus* belonged to this group; 12 species from the *Aphyllophorales* group have been found, most of them fairly common in Reserve. Fungi from the other systematical groups were not noted frequently: 4 species from *Ascomycetes* (*Sphaeriales*), 4 species from *Tremellales*, only 3 species from *Gasteromycetes* (*Crucibulum leave, Cyathus striatus* and *Lycoperdon pyriforme*) – all rare in the Reserve.

In addition a lot of very small woody remnants or tiny twigs burried in the litter of *Tilio-Carpinetum* in the Skołczanka Reserve were inhabited by a number of very small carpophores which could often be seen only by magnifying glass. However, the detailed examination of these fungi was not the subject of the present investigations. Therefore the real number of lignicolous saprophytes in the studied forest may appear greater in fact.

Mycorrhizal species. This group includes the greatest number of species (50) – all of them are ectomycorrhizal fungi. They were associated predominantly with decidous trees (*Carpinus betulus, Fagus sylvatica, Quercus robur*), exceptionally with the coniferous tree (*Pinus sylvestris*). Some of them were very common (*Hygrophorus eburneus, Lactarius necator, Tricholoma sulphureum*), others very rare (*Cortinarius decipiens, Inocybe mixtilis, Limacella illinita*).

Among the mycorrhizal species *Agaricales* was the most numerous group with 24 species (Table 3). The species from the genus *Amanita, Inocybe, Laccaria* and *Tricholoma* belonged to this group. Many mycorrhizal fungi were included in the order *Russulales*. All species from the genus *Lactarius* (8) and *Russula* (11) which were noted in Skołczanka Reserve belonged to this order. Among the 19 species only *Lactarius blennius, L. necator* and *L. quietus* were common in the Reserve. All the species from the genus *Russula* did not occur commonly. Mycorrhizal fungi from the other taxonomical groups were rarely noted: *Boletales* – 4 species, *Aphyllophorales* – 2 (*Cantharellus cibarius, Ramaria eumorpha*), *Gasteromycetes* – 1 (*Scleroderma citrinum*).

It should be noted that fruit bodies of *Cantharellus cibarius* were never founded

in the thick layer of the litter in Skołczanka Reserve. They only grew on soil with a very thin litter layer. It is interesting that J a n s e n et al., 1985 (cyt. after Arnolds, 1989) also reported „a strong preference of *Cantharellus cibarius* for soil with a thin litter layer and low organic matter content".

F a c u l t a t i v e p a r a s i t e s. In the studied forest this group of fungi was quite small (only 5 species). Three of them belonged to the order *Aphyllophorales*: *Chondrostereum purpureum* (on the laying branches of *Fagus sylvatica*), *Heterobasidion annosum* (on the bases of the trunks of *Pinus sylvestris*) and *Piptoporus betulinus* (on the logs of *Betula verrucosa*). Only the latter was fairly common in the Reserve, the two remaining species were rare. In the Reserve *Armillaria mellea* was the only facultative parasite from the order *Agaricales*. The species was fairly common in the studied forest. It usually fructified from August to the mid of October.

Nectria cinnabarina was the only facultative parasite from the class *Ascomycetes* noted in the Skołczanka Reserve. This species was not common in the studied forest. Its red fruit bodies growing on the twigs formed both teleomorph and anamorph stages.

The boundary between facultative parasites and lignicolous saprophytes is not sharp. These fungi are able to attact the living trees causing various kind of wood-rot. Then, after the death of the host they can continue to live as a true saprophyte.

C o n c l u s i o n s. It is quite difficult to assign a particular species of fungi to a definite ecological group. As A r n o l d s (1988) indicates there are some fungi which should not be assigned only to one ecological group. Nevertheless the distinguished groups give a general description of kind of life of higher fungi in the Skołczanka Reserve. Some proportions of ecological groups can be obtained only for National Parks or Reserves. In the forests with intensive human management the number of lignicolous fungi is much smaller due to the lack of dead logs, lying branches, twigs and woody remnants.

DISCUSSION

Among many mycosociological investigations carried out in deciduous forests in Poland only some refer to the *Tilio-Carpinetum* association (H o ł o w n i a, 1978, 1985; L i s i e w s k a, 1978, 1979; L i s i e w s k a, R y b a k, 1990; Ł a w r y n o w i c z, 1973; W o j e w o d a, 1974, 1975, 1978; and others).

Oak-hornbeam forests are especially rich in fungi. They are particularly abondant in National Parks and Reserves, where the human activity is corsiderably restricted. The thick layer of litter composed of plant remains and woody remnants creates an excellent habitat for terrestrial and lignicolous fungi. In these forests the number of fungi species is usually greater than that of higher plants. These observations were also confirmed by the investigations carried at in Skołczanka Reserve. D z w o n k o and L o s t e r (1992) reported 86 species of higher plants (trees, shrubs and herbs) from *Tilio-Carpinetum* in the Skołczanka Reserve In the present study

159 species of fungi were noted in the same forest. Lisiewska (1965), Pirk (1948), Runge (1963) and Šmarda (1960) noted in their researches that the number of species of fungi was greater than that of higher plants in *Querco--Carpinetum* association.

The great number of species of fungi noted in the present study may be associated with calcareous soil. According to Hering (1966) the number of macromycetes growing on limestone compared to those occuring on acidic soil in the woodlands in Reserve is much on greater. Pilát (1969) has noted that the oak forests found on soil without limestone in Czechoslovakia are characterized by a poorer mycoflora in the contrast to forests occuring on calcareous soil.

Only 6 species among the 10, iniciated as locally characteristic, for *Tilio--Carpinetum* were also published by other authors as typical of oak-hornbeam forests. There are the following species:

Cobyllia dryophila

In Poland: Kazimierz Biskupi near Konin (Lisiewska, Wójcik, 1984), Park in Uniejów, district Konin (Lisiewska, Rybak, 1990).

Other countries: Woroneż Reserve in the Russia (Czastuchin, Nikołajewskaja, 1953).

Lactarius quietus

In Poland: National Park of Białowieża (Nespiak, 1959), Dębina Reserve, district Piła (Lisiewska, Bujakiewicz, 1976), Świętokrzyski National Park (Lisiewska, 1978), Park in Uniejów, district Konin (Lisiewska, Rybak, 1990).

Other countries: near Turku in Finland (Kallio, 1963), Germany (Runge, 1963), Central Europe (Neuhoff, 1956; Michael, Hennig, 1967).

Lepista nebularis

In Poland: Dębina Reserve, district Piła (Lisiewska, Bujakiewicz, 1976), Polanka Haller near Skawina, district Kraków (Rajba, 1982).

Other countries: in oak-hornbeam forest in Czechoslovakia (Pilát, 1969).

Lycoperdon perlatum

In Poland: Polanka Haller near Skawina, district Kraków (Rajba, 1982).

Mycena pura

In Poland: Polanka Haller near Skawina, district Kraków (Rajba, 1982).

Other countries: Woroneż Reserve in the Russia (Czastuchin, Nikołajewskaja, 1953), Central Europe (Neuhoff, 1956).

Tricholoma sulphureum

In Poland: Kazimierz Biskupi near Konin (Lisiewska, Wójcik, 1984).

Other countries: Central Europe (Neuhoff, 1956), near Brno in warm oak--hornbeam forest in Czechoslovakia (Šmarda, 1960), near Turku in Finland (Kallio, 1963).

The remaining 4 species (*Hygrophorus eburneus, Lactarius necator, Lepista gilva* and *Oudemansiella radicata*) occuring abundantly in the Skołczanka Reserve

and indicating well *Tilio-Carpinetum* association in this area – in other regions never occured in the same association in great abundance.

It is worth mentioning that some fungi which were rare or absent in studied forest in other regions were observed to be common in the same forest communities. This referes both to the spring and autumn species:

Caloscypha fulgens (Pers.) Boud. – was fairly abundant in the spring in *Tilio-Carpinetum* in Świętokrzyski Natinal Park (L i s i e w s k a, 1978) – absent in Skołczanka.

Collybia peronata (Bolt.: Fr.) Sing. – L i s i e w s k a and R y b a k (1990) included it among species frequently occuring in *Tilio-Carpinetum* in the Park in Uniejów, district Konin – rare in Skołczanka.

Craterellus cornucopioides (L.) Pers. – according to N e u h o f f (1956) and M i c h a e l, H e n n i g (1967) this species usually appears in great numbers in *Querco-Carpinetum* in Europe – absent in Skołczanka.

Entoloma nidorosum (Fr.) Quél. – this fungus is considered to be one of the species characteristic of *Querco-Carpinetum* in National Park of Białowieża (N e s p i a k, 1959), in Wielkopolska province (L i s i e w s k a, 1965) and in Ojców National Park (W o j e w o d a, 1975) – absent in Skołczanka.

Kuehneromyces mutabilis (Schaeff.: Fr.) Sing. et Smith – H o ł o w n i a (1978) included it among characteristic species of *Tilio-Carpinetum* in northern Poland near Toruń – rare in Skołczanka.

Lactarius piperatus (L.) S. F. Gray – S a ł a t a (1968) noted that it frequently occured in *Querco-Carpinetum* near Annopol, district Tarnobrzeg – rare in Skołczanka.

Lactarius pyrogalus Bull.: Fr. – it is one of the most frequently occuring species in the oak-hornbeam forests (often under hazel) in the Central Europe (N e u h o f f, 1956; B o h u s, B a b o s, 1960); in Poland it was noted many times for this association, among others from Świętokrzyski National Park (L i s i e w s k a, 1978) and Ojców National Park (W o j e w o d a, 1975) – absent in Skołczanka.

Lactarius serifluus DC: Fr. – R u n g e (1963) noted that this species of some importance in oak-hornbeam forests in Germany; K a l l i o (1963) mentioned it as a dominating fungus species in *Querco-Carpinetum* near Turku in Finland – absent in Skołczanka.

Macrotyphula fistulosa (Fr.) R.H. Petersen (= *Clavariadelphus fistulosus* (Fr.) Corner) – according to L i s i e w s k a (1965) it is one of the predominant autumn species in *Querco-Carpinetum* association in Wielkopolska province – absent in Skołczanka.

Mycena sanguinolenta (Alb. et Schwein.) Fr. – H o ł o w n i a (1978) included it among characteristic species of *Tilio-Carpinetum* in north Poland, near Toruń – rare in Skołczanka.

Sclerotinia tuberosa (Hedw.) Fuck. – is common in *Querco-Carpinetum* in Wielkopolski National Park in spring (L i s i e w s k a, 1965) – absent in Skołczanka.

Tricholoma scalpturatum (Fr.) Quél. – this species frequently occured in oak-hornbeam forests in Germany (R u n g e, 1963); according to W o j e w o d a (1975) it is locally characteristic of *Tilio-Carpinetum* in Ojców National Park – absent in Skołczanka.

It appears that the mycoflora of *Tilio-Carpinetum* association in Skołczanka Reserve has an individual character and cannot be identified with lists of fungi given by other authors from the same associations in other regions. This specific character mainly results from the presence of *Fagus sylvatica* which is assuated with the fungi which are bound to this tree. As a result, the mycoflora of the *Tilio-Carpinetum* in Skołczanka Reserve is to certain extend similar to the of *Fagetum carpaticum.*

The investigations on seasonal changes of the fungus florain various plant associations were carried out by many authors but phenological data from *Tilio-Carpinetum* association were not often reported. In Poland some studies of this association were conducted. They were carried out in the following regions: National Park of Białowieża (N e s p i a k, 1959), Wielkopolska province (L i s i e w s k a, 1961, 1965), in the region of Konin and Toruń (H o ł o w n i a, 1978, 1985; L i s i e w s k a, W ó j c i k, 1984) and Ojców National Park (W o j e w o d a, 1975). The results of these studies could be to certain extend compared with those from the Skołczanka Reserve.

The results of the seasonal fluctuations of the mycoflora described by the authors agree on two points with those given in the present paper:

1. The first fruit bodies appear in the oak-hornbeam forests in April; in May the fructification is still rather scant.
2. In autumn the end of fructification falls in all regions at the same time i.e. in November, together with the falling of the leaves and the first frosts.

However there is some divergence in the time of the peak of fruitication. In the Skołczanka Reserve the highest number of fruit bodies was noted in the second part od September (Fig. 3). According to other authors in other regions, the peak of fructification occured in various periods: in the second part of August, in the first part of September, in the second part of September or in the first part of October.

Only in two regions the time of maximum fructification was the same as in the studied forest (in the second part of September):

– in *Tilio-Carpinetum typicum* near Toruń in 1972-1974 (H o ł o w n i a, 1978, 1985);

– in *Tilio-Carpinetum mellitetosum* (on plot no 4) in 1965 and in *Tilio-Carpinetum typicum* (on plot no 5) in 1965 in the Ojców National Park (W o j e w o d a, 1975).

Fructification of some species which occured twice in the same years was observed in Skołczanka Reserve as well as in other regions:

a) in Wielkopolski National Park – *Marasmius foetidus, Mycena alcalina, M. parabolica* and *Plicaria badia* were observed in *Querco-Carpinetum medioeuropaeum* (L i s i e w s k a, 1961);

b) in Ojców National Park – *Hypholoma fasciculare, Marasmius rotula* and *Russula lutea* in *Tilio-Carpinetum typicum* (W o j e w o d a, 1975);

c) in the region of Toruń – *Collybia dryophila, Mycena galopoda* and *M. phyllogena* in *Tilio-Carpinetum typicum* (H o ł o w n i a, 1985).

The comparision of fructification of *Hypholoma fasciculare* which occured twice and was observed both in the Skołczanka Reserve and in the Ojców National Park in May (first period of fructification) and in October (second period) seems to be highly interesting: Skołczanka Reserve: 2.V-19.V.1990 and 29.VIII-25.X.1990; Ojców National Park (W o j e w o d a, 1975): 18.V-29.V.1962 and 28.VIII-26.X.1962 (with small intervals).

This unusual similarity in the time of fructification in different regions and in different years must be accidental, but it seems certainly interesting for studies on autecology of *Hyphoma fasciculare*.

On the grounds of the results of floristical and ecological studies it should be stated that the flora of higher fungi of *Tilio-Carpinetum* in the studied forest is rich and interesting. Such investigations should be continued but it is necessary to conduct them for a longer period.

LIST OF SPECIES

Ecological groups:
S – terrestrial saprophytic species
L – lignicolous saprophytic species
P – facultative parasitic species on woody substrates
M – mycorrhizal symbionts

Abundance:
1 – rare
2 – uncommon (sporadic)
3 – fairly common
4 – common
f – forming fairy rings

Species	Ecological groups				Abundance				
ASCOMYCETES									
Pezizales									
Humaria hemisphaerica (Wiggers: Fr.) Fuckel	S	–	–	–	–	–	2	–	–
Otidea onotica (Pers.: Fr.) Fuckel	S	–	–	–	–	–	–	1	–
Otidea umbrina (Pers.) Bres.	S	–	–	–	–	–	–	1	–
Tarzetta cupularis (L.: Fr.) Lambotte ss. Dennis	S	–	–	–	–	–	–	1	–
Sphaeriales									
Diatrype disciformis (Hoffm.: Fr.) Fr.	–	L	–	–	–	3	–	–	–
Diatrype stigma (Hoffm.: Fr.) Fr.	–	L	–	–	–	3	–	–	–
Hypoxylon fragiforme (Pers.: Fr.) Kickx	–	L	–	–	–	3	–	–	–
Nectria cinnabarina (Tode: Fr.) Fr.	–	–	P	–	–	–	2	–	–
Xylaria hypoxylon (L. ex Hooker) Grev.	–	L	–	–	–	3	–	–	–
BASIDIOMYCETES									
Tremellales									
Exidia plana (Wigg.) Donk	–	L	–	–	–	–	–	1	–

Pseudohydnum gelatinosum (Scop.: Fr.) P. Karst.	–	L	–	–	–	–	–	1	–
Sebacina epigaea (Berk. et Br.) Neuh.	–	L	–	–	–	–	–	1	–
Tremella mesenterica Retz.: Hook.	–	L	–	–	–	–	–	1	–
Aphyllophorales									
Bjerkandera adusta (Willd.: Fr.) P. Karst.	–	L	–	–	–	–	2	–	–
Cantharellus cibarius Fr.	–	–	–	M	–	–	–	1	–
Chondrostereum purpureum (Pers.: Fr.) Pouz.	–	–	P	–	–	–	–	1	–
Clavulina cinerea (Fr.) Schröter	S	–	–	–	–	–	2	–	–
Clavulina cristata (Fr.) Schöter	S	–	–	–	–	–	2	–	–
Daedaleopsis confragosa (Bolt.: Fr.) Schröter	–	L	–	–	–	3	–	–	–
Ganoderma lipsiense (Batsch) Atk.	–	L	–	–	–	–	2	–	–
Heterobasidion annosum (Fr.) Bref.	–	–	P	–	–	–	2	–	–
Lenzites betulina (L.: Fr.) Fr.	–	L	–	–	–	–	–	1	–
Macrotyphula juncea (Fr.) Berthier	S	–	–	–	–	–	–	1	–
Merulius tremellosus Schrad.: Fr.	–	L	–	–	–	–	–	1	–
Peniophora laeta (Fr.) Donk	–	L	–	–	–	–	–	1	–
Piptoporus betulinus (Bull.: Fr.) P. Karst.	–	–	P	–	–	3	–	–	–
Polyporus varius (Pers.): Fr.	–	L	–	–	–	–	–	1	–
Ramaria eumorpha (P. Karst.) Corner	–	–	–	M?	–	3	–	–	1
Schizopora paradoxa (Schrad.: Fr.) Donk (s.l.)	–	L	–	–	–	3	–	–	–
Steccherinum ochraceum (Pers.:Fr.) S. F. Gray	–	L	–	–	–	–	2	–	–
Stereum hirsutum (Willd.: Fr.) S. F. Gray	–	L	–	–	–	3	–	–	–
Trametes hirsuta (Wulf.: Fr.) Pilát	–	L	–	–	–	3	–	–	–
Trametes versicolor (L.: Fr.) Pilát	–	L	–	–	–	3	–	–	–
Boletales									
Chalciporus piperatus (Bull.: Fr.) Bataille	–	–	–	M	–	–	–	1	–
Leccinum scabrum (Bull.: Fr.) S. F. Gray	–	–	–	M	–	–	–	1	–
Paxillus involutus (Batsch.: Fr.) Fr.	–	–	–	M	–	–	–	1	–
Xerocomus chrysenteron (Bull.) Quélet	–	–	–	M	–	3	–	–	–
Agaricales									
Agaricus abruptibulbus Peck	S	–	–	–	–	3	–	–	–
Agaricus semotus Fr.	S	–	–	–	–	–	–	1	–
Agaricus silvaticus Schaeff.	S	–	–	–	–	–	2	–	f
Agaricus silvicola (Vitt.) Sacc.	S	–	–	–	–	3	–	–	–
Agrocybe erebia (Fr.) Kühner	S	–	–	–	–	–	–	1	–
Agrocybe praecox (Pers.: Fr.) Fayod	S	–	–	–	–	–	–	1	–
Amanita citrina (Schaeff.) Pers.	–	–	–	M	–		–	1	–
Amanita muscaria (L.: Fr.) Pers.	–	–	–	M	–	–	2	–	–
Amanita phalloides (Fr.) Link	–	–	–	M	–	3	–	–	–
Amanita rubescens Pers.: Fr.	–	–	–	M	–	–	2	–	–
Armillariella mellea (Vahl.: Fr.) P. Karst.	–	–	P	–	–	3	–	–	–
Clitocybe candicans (Pers.: Fr.) Kummer	S	–	–	–	–	3	–	–	–
Clitocybe clavipes (Pers.: Fr.) Kummer	S	–	–	–	–	–	–	1	–
Clitocybe hydrogramma (Bull.:Fr.) Kummer	S	–	–	–	–	–	2	–	–
Clitocybe inornata (Sow.: Fr.) Gillet	S	–	–	–	–	–	2	–	–

cont. List of sp.

Species	Ecological groups				Abundance				
Clitocybe odora (Bull.: Fr.) Kummer	S	–	–	–	–	3	–	–	–
Clitocybe umbilicata (Schaeff.: Fr.) Singer	S	–	–	–	–	–	–	1	–
Collybia butyracea (Bull.: Fr.) Kummer	S	–	–	–	–	3	–	–	–
Collybia dryophila (Bull.: Fr.) Kummer	S	–	–	–	4	–	–	–	–
Collybia peronata (Bolt.: Fr.) Singer	S	–	–	–	–	–	–	1	–
Coprinus impatiens (Fr.) Quélet	S	–	–	–	–	–	2	–	–
Coprinus micaceus (Bull.: Fr.) Fr.	–	L	–	–	–	–	–	1	–
Coprinus plicatilis (Curt.: Fr.) Fr.	S	–	–	–	–	–	–	1	–
Coprinus xanthothrix Romagn.	S	–	–	–	–	3	–	–	–
Cortinarius (*Telamonia*) *bovinus* Fr.	–	–	–	M	–	–	–	1	–
Cortinarius (*Telamonia*) *decipiens* (Pers.: Fr.) Fr.	–	–	–	M	–	–	–	1	–
Crepidotus variabilis (Pers.: Fr.) Kummer	–	L	–	–	–	3	–	–	–
Cystoderma amianthinum (Scop.: Fr.) Fayod	S	–	–	–	–	–	–	1	–
Cystoderma granulosum (Batsch: Fr.) Kühn.	S	–	–	–	–	–	2	–	–
Entoloma sericeum (Bull.) Quélet	S	–	–	–	–	–	–	1	–
Entoloma speculum (Fr.) Kummer	S	–	–	–	–	–	–	1	–
Flammulina velutipes (Curt.: Fr.) P. Karsten	–	L	–	–	–	–	–	1	–
Gymnopilus hybridus (Fr.) Singer	–	L	–	–	–	–	–	1	–
Hebeloma hiemale Bres.	–	–	–	M?	–	–	–	1	–
Hebeloma sinapizans (Fr.) Gillet	–	–	–	M	–	–	2	–	–
Hydropus subalpina (Hoehn.) Singert	–	L	–	–	–	–	–	1	–
Hygrophorus eburneus (Bull.: Fr.) Kummer	–	–	–	M	4	–	–	–	–
Hypholoma fasciculare (Huds.: Fr.) Kummer	–	L	–	–	–	3	–	–	–
Hypholoma sublateritium (Fr.) Quélet	–	L	–	–	–	–	–	1	–
Inocybe asterospora Quélet	–	–	–	M	–	–	2	–	–
Inocybe brunneoatra Heim	–	–	–	M	–	–	–	1	–
Inocybe fastigiata (Schaeff.) Quélet	–	–	–	M	–	–	2	–	–
Inocybe geophylla (Sow.: Fr.) Kummer	–	–	–	M	–	3	–	–	–
Inocybe maculata Boud.	–	–	–	M	–	–	–	1	–
Inocybe mixtilis Britz.	–	–	–	M	–	–	–	1	–
Kuehneromyces mutabilis (Schaeff.: Fr.) Singer et Smith	–	L	–	–	–	–	–	1	–
Laccaria amethystina (Bolt.) Murr.	–	–	–	M	–	3	–	–	–
Laccaria laccata (Scop.: Fr.) Berk. et Br.	–	–	–	M	–	–	2	–	–
L ota clypeolaria (Bull.: Fr.) Kummer	S	–	–	–	–	–	2	–	–
Lepiota cristata (All et Schwein: Fr.) Kummer	S	–	–	–	–	–	2	–	–
Lepiota ignivolvata Bousset, Joss.	S	–	–	–	–	–	–	1	–
Lepiota pseudohelveola Kühn.: Hora	S	–	–	–	–	–	–	1	–
Lepista gilva (Pers.: Fr.) Roze	S	–	–	–	4	–	–	–	f
Lepista irina (Fr.) Bigelow	–	–	–	M	–	–	–	1	f
Lepista nebularis (Batsch: Fr.) Harmaja	S	–	–	–	4	–	–	–	f
Lepista nuda (Bull.: Fr.) Cooke	S	–	–	–	–	3	–	–	f
Limacella illinita (Fr.) Murr.	–	–	–	M	–	–	–	1	–

Macrolepiota konradii (Huijsm. et Orton) Moser	S	–	–	–	–	–	–	1	–
Macrolepiota procera (Scop.: Fr.) Singer	S	–	–	–	–	3	–	–	–
Macrolepiota rhacodes (Vitt.) Singer	S	–	–	–	–	–	–	1	–
Marasmiellus remealis (Bull.: Fr.) Singer	–	L	–	–	–	–	–	1	–
Marasmius cohaerens (Pers.: Fr.) Fr.	S	–	–	–	–	–	2	–	–
Marasmius rotula (Scop.: Fr.) Fr.	–	L	–	–	–	–	–	1	–
Marasmius wynnei Berk. et Br.	S	–	–	–	–	–	2	–	–
Mycena epipterygia (Scop.: Fr.) S. F. Gray	S	–	–	–	–	3	–	–	–
Mycena galericulata (Scop.: Fr.) S. F. Gray	–	L	–	–	–	–	–	1	–
Mycena galopoda (Pers.: Fr.) Kummer	S	–	–	–	–	–	2	–	–
Mycena maculata Karsten	–	L	–	–	–	–	–	1	–
Mycena polygramma (Bull.: Fr.) S. F. Gray	–	L	–	–	–	3	–	–	–
Mycena pura (Pers.: Fr.) Kummer	S	–	–	–	4	–	–	–	–
Mycena sanguinolenta (Alb. et Schwein.) Fr.	S	–	–	–	–	–	–	1	–
Mycena stylobates (Pers.: Fr.) Kummer	S	–	–	–	–	–	2	–	–
Mycena vitilis (Fr.) Quélet	S	–	–	–	–	–	–	1	–
Oudemansiella longipes (Bull.) Moser	S	–	–	–	–	–	–	1	–
Oudemansiella radicata (Relhan: Fr.) Singer	–	L	–	–	4	–	–	–	–
Pholiota flammans (Fr.) Kummer	–	L	–	–	–	–	–	1	–
Pluteus atricapillus (Batsch) Singer	–	L	–	–	–	3	–	–	–
Pluteus romellii (Britz.) Sacc.	–	L	–	–	–	–	–	1	–
Pluteus salicinus (Pers.: Fr.) Kummer	–	L	–	–	–	–	–	1	–
Psathyrella candolleana (Fr.:Fr.) Maire	–	L	–	–	–	–	–	1	–
Psathyrella corrugis (Pers.: Fr.) Konrad et Maublanc	S	–	–	–	–	–	–	1	–
Psathyrella hydrophila (Boull.) Maire	–	L	–	–	–	–	–	1	–
Psathyrella subatrata (Batsch: Fr.) Gillet	S	–	–	–	–	–	–	1	–
Psylocybe crobula (Fr.) M. Lange: Singer	–	L	–	–	–	–	–	1	–
Rickenella fibula (Bull.: Fr.) Raith.	S	–	–	–	–	–	–	1	–
Stropharia aeruginosa (Curt.: Fr.) Quélet	S	–	–	–	–	3	–	–	–
Tricholoma lascivum (Fr.) Gillet	–	–	–	M	–	–	2	–	–
Tricholoma saponaceum (Fr.) Kummer	–	–	–	M	–	–	–	1	–
Tricholoma scalpturatum (Fr.) Quélet	–	–	–	M	–	–	–	1	–
Tricholoma sulphureum (Bull.: Fr.) Kummer	–	–	–	M	4	–	–	–	–
Tricholoma ustale (Fr.: Fr.) Kummer	–	–	–	M	–	–	–	1	–
Tricholomopsis rutilans (Schaeff.: Fr.) Singer	–	L	–	–	–	3	–	–	–
Russulales									
Lactarius aspideus var. *flavidus* Boud.	–	–	–	M	–	–	–	1	–
Lactarius blennius (Fr.) Fr.	–	–	–	M	–	3	–	–	–
Lactarius helvus (Fr.) Fr.	–	–	–	M	–	–	–	1	–
Lactarius mitissimus (Fr.) Fr.	–	–	–	M	–	–	–	1	–
Lactarius necator (Bull.: Fr.) P. Karst.	–	–	–	M	4	–	–	–	–
Lactarius piperatus (L.) S. F. Gray	–	–	–	M	–	–	–	1	–
Lactarius quietus Fr.	–	–	–	M	4	–	–	–	–
Lactarius vellereus var. *velutinus* Bert.	–	–	–	M	–	–	–	1	–

cont. List of sp.

Species	Ecological groups				Abundance				
Russula alutacea (Pers.: Fr.) Fr.	–	–	–	M	–	–	–	1	–
Russula chamaeleontina (Fr.) Fr. ss. Romagn.	–	–	–	M	–	–	2	–	–
Russula cyanoxantha (Schaeff.) Fr.	–	–	–	M	–	–	2	–	–
Russula fellea (Fr.) Fr.	–	–	–	M	–	–	2	–	–
Russula foetens (Pers.: Fr.) Fr.	–	–	–	M	–	–	–	1	–
Russula fragilis (Pers.: Fr.) Fr.	–	–	–	M	–	–	2	–	–
Russula mairei Singer	–	–	–	M	–	–	–	1	–
Russula nigricans (Bull.) Fr.	–	–	–	M	–	–	2	–	–
Russula rosacea (Pers.) S.F. Gray	–	–	–	M	–	–	–	1	–
Russula solaris Ferd. et Winge	–	–	–	M	–	–	–	1	–
Russula violeipes Quélet	–	–	–	M	–	–	–	1	–
Sclerodermatales									
Scleroderma citrinum Pers.	–	–	–	M	–	–	–	1	–
Nidulariales									
Crucibulum laeve (Huds.) Kambly	–	L	–	–	–	–	–	1	–
Cyathus striatus (Huds.) Pers.	–	L	–	–	–	–	–	1	–
Lycoperdales									
Calvatia excipuliformis (Schaeff.: Pers.) Perd.	S	–	–	–	–	–	–	1	–
Geastrum sessile (Sow.) Pouzar	S	–	–	–	–	–	–	1	–
Geastrum vulgarum Vitt.	S	–	–	–	–	–	–	1	–
Lycoperdon echinatum Pers.: Pers.	S	–	–	–	–	–	–	1	–
Lycoperdon molle Pers.: Pers.	S	–	–	–	–	–	–	1	–
Lycoperdon perlatum Pers.: Pers.	S	–	–	–	4	–	–	–	–
Lycoperdon pyriforme Schaeff.: Pers.	–	L	–	–	–	–	–	1	–
Phallales									
Phallus impudicus L.: Pers.	S	–	–	–	–	3	–	–	–

Acknowledgements. I wish to express my gratitude to Professor Dr Władysław W o j e w o d a for his kind identifying of the species *Sebacina epigaea* and *Steccherinum ochraceum* and for verifying the species *Schizopora paradoxa*. I also would like to thank Professor Dr Anna M e d w e c k a - K o r n a ś for reviewing the manuscript and suggesting valuable improvements. I am much indebted to Dr Marian D r u ż k o w s k i for his help with some technical works and advise with getting in touch with the Meteorological Station in Tyniec.

REFERENCES

A r n o l d s E., 1981. Ecology and coenology of macrofungi in grasslands and moist heathlands in Drenthe, the Netherlands. Bibl. Mycol. 83: 1-407.

A r n o l d s E., 1988, Status and classification of fungal communities. Comm. no. 333 of the Biological Station, Wijster: 153-165.

A r n o l d s E., 1989. Changes in frequency and distribution of macromycetes in the Netherlands in relation to a changing environment. Fungi Atque Loci Natura (Atti del IV Conv. Intern li Micol.: 163-232.

Bałanda B., 1987. Macromycetes rezerwatu Skołczanka i terenów przyległych w okolicy Tyńca (praca magisterska - ms.).

Bohus G., Babos M., 1960. Coenology of terricolous macroscopic fungi of decidous forests. Bot. Jb. 80 (1): 1-100.

Breitenbach J., Kränzlin F., 1984. Pilze der Schweiz (*Ascomycetes*). Luzern.

Dzwonko Z., Loster S., 1990. Vegetation differentiation and secondary succession on limestone hill in southern Poland. Journal of Vegetation Science 1: 615-622.

Dzwonko Z., Loster S., 1992. Vegetation and secondary succession in the grassland - forest Skołczanka Reserve near Cracow, southern Poland. Ochrona Przyrody (in press).

Hering T. F., 1966. The terricolous higher fungi of four Lake District Woodlands. Trans. Br. Mycol. Soc. 49: 369-383.

Hołownia I., 1978. Results of studies on the production of fungi fruit bodies in the forest ecosystems of the reserve „Las Piwnicki". Acta Univ. Nic. Coper. 21: 61-73.

Hołownia I., 1985. Phenology of fruit bodies of fungi in the Las Piwnicki reserve in the period 1972-1975. Acta Univ. Nic. Coper. 27: 47-55.

Jansen E., Dobben H. Van, De Wit T., 1985. Achteruitgang van de cantharel in Nederland. Wetensch. Meded. Kon. Natuurh. Vereiniging 167: 59-69 (after Arnolds, 1989).

Jülich W., 1984. Die Nichtblätterpilze, Gallertpilze und Bauchpilze (*Aphyllophorales, Heterobasidiomycetes, Gasteromycetes*). Kleine Krytogamenflora IIb/1. VEB, G. Fischer, Jena.

Kallio P., 1963. Zur Verbreitung einiger in Finnland südlichen Pilze, besonders in der südwestlichen Eichenzone. Karstenia 6-7; 35-76.

Lisiewska M., 1965. Higher fungi of *Querceto-Carpinetum* of the Wielkopolska province (in Polish). Acta Mycol. 1: 169-268.

Lisiewska M., 1978. Macromycetes in forest associations of the Świętokrzyski National Park. Acta Mycol. 14 (1, 2): 163-191.

Lisiewska M., 1979. Flora of macromycetes of the Świętokrzyski National Prak. Acta Mycol. 15(1): 21-43.

Lisiewska M., Bujakiewicz A., 1976. V. Macromycetes in the forest associations. Bad. Fizj. Pol. Zach. 29: 119-134.

Lisiewska M., Rybak M., 1990, Macrofungi of forest associations in the Park of Uniejów (Central Poland). Bad. Fizj. Pol. Zach. 40: 5-28.

Lisiewska M., Wójcik J., 1984. Mycosociological studies in some forest associations near Kazimierz Biskupi in the Konin Province. Bad. Fizj. Pol. Zach. 35: 25-34.

Ławrynowicz M., 1973. Higher macroscopic fungi in the oak-hornbeam forests of central Poland. Acta Mycol. 9 (2): 133-204.

Michael E., Hennig B., 1967. Handbuch für Pilzfreunde 4. VEB, G. Fischer, Jena.

Michael E., Hennig B., Kreiser H., 1983. Handbuch für Pilzfreunde 5. VEB, G. Fischer, Jena.

Moser M., 1983. Die Röhrlinge und Blätterpilze (*Polyporales, Boletales, Agaricales, Russulales*). Kleine Kryptogamenflora. IIb/2. E. Fischer, Stuttgart - New York.

Nespiak A., 1959. The investigations on the character of the correlations between the higher fungi and wood associations in the National Park of Białowieża. Monogr. Bot. 8: 3-141.

Neuhoff W., 1956. Die Milchlinge (Lactarii). Die Pilze Mitteleuropas IIb. J. Klinkhardt, Bad Heilbrunn.

Pilét A., 1969. Houby Československa ve svém životním prostředi. Česk. Akad. Véd, Praha.

Pirk W., 1948, Zur Soziologie der Pilze im *Querceto-Carpinetum*. Zeitschr. Pilzkunde 21(1): 11-20.

Rajba M., 1982. Macromycetes w wybranych zespołach leśnych okolic Polanki Haller na Pogórzu Wielickim – praca magisterska (ms.).

Runge A., 1963. Pilzsukzession in einem Eichen-Hainbuchenwald. Zeitschr. Pilzkunde 29 (3/4): 65-72.

Sałata B., 1968. Beiträge zur Pilzflora in der Gegend von Annopol. Acta Mycol. 4(1): 53-70.

Skirgiełło A., 1991. *Mycota, Basidiomycetes, Russulales, Russulaceae* I, *Russula*, 20. PWN, Warszawa – – Kraków.

Šmarda F., 1960. Mycofloristicka charakteristika rostlinných společenstev Čebinky u Brna. Čes. Mykol. 14: 222-228.

Traczyk T., 1962. Materiaux pour la differentiation des groupements *Querco-Carpinetum* en Pologne. Acta Soc. Bot. Pol. 31: 275-304.

Wojewoda W., 1974. Macromycetes of the Ojców National Park. I. The flora. Acta Mycol. 10(2): 181-265.

Wojewoda W., 1975. Macromycetes of the Ojców National Park. II. Phytosociological, ecological and geographical characterization. Acta Mycol. 11 (2): 163-212.

Wojewoda W., 1978. Macromycetes of the Lipowka nature reserve in the Niepołomice Forest. Zakł. Ochr. Przyr. PAN, Studia Naturae, ser. A, 17: 159-168.

Wojewoda W., 1981. Mała Flora Grzybów Vol. 2, *Basidiomycetes, Tremellales, Auriculariales, Septobasidiales*. PWN, Warszawa – Kraków.