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Macromycetes of beech forests within the eastern part of the *Fagus* area in Europe

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This work presents the author's view on the habitat of individual forest communities based on the fungi she has collected and gives a comparison of the mycoflora of beech forests in Poland and in south and central Europe. The beech forests were studied by the phytosociological method. Fruit bodies occurring on the soil, in the litter and on rotten wood were studied.

INTRODUCTION

The role of macromycetes in various plant communities has interested botanists for a long time. The term "macromycetes" generally concerns fungi with fleshy fruit bodies. The author endeavoured to establish the closeness of relations between the particular fungal species and forest associations and also lower phytosociological units within these communities.

The first observations in this respect were performed in oak-hornbeam associations in Poznań Province, concurrently with research on the contribution of macromycetes in communities of fertile and acidophilous lowland beech forests, initially in the Beech Forest near Szczecin and later in the Wolin Island National Park (Lisiewska 1960, 1961, 1963, 1965, 1966a). Later the scope of research was extended to other regions of West Pomerania in order to obtain a wider aspect of the mycofloral composition of the beech forestes of the Polish Lowland.

The author alone or together with other Polish mycologists made observations on patches of fertile Carpathian beech forests in the Świętokrzyski National Park and in the Western Bieszczady Mts. (Domański et al. 1960, 1963, 1967, 1970). Finally, comparative mycological data were collected autside Poland, namely near the northern border of the beech range in Europe in Denmark (Lange, Lisiewska 1969) and near its southern border in Yugoslavia (Lisiewska, Jelić 1971; Tortić, Lisiewska 1972).

The present work is an attempt of the synthesis of several years' studies on the contribution of macromycetes to forest communities, in which the beech is the main component, with particular consideration of the north-eastern part of the beech range. The author endeavoured to establish the relationships of this group of fungi producing fruit bodies in various habitats and on various substrates (on soil, fallen leaves, branches and rotten wood) to the entire phytocoenose. An attempt was made also to determine the diagnostic role of macromycetes in phytosociological studies.

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VIEWS ON THE ROLE OF FUNGI IN THE STRUCTURE OF PHYTOCOENOSES AND METHODS EMPLOYED

The relations between groups of cryptogams and communities of vascular plants have for a long time interested not only phytosociologists, but also botanists-taxonnomists and specialists studying particular groups of cryptogams. In Poland this problem was considered by Kornaś (1957, 1966) and other authors.

At the International Symposium in Stolzenau in 1964 which was devoted to phytosociological systematics, Barkman (1968) discussed the problem of microcommunities within a biocoenose and made the following points:

I. Authors describe biocoenoses as a whole without distinguishing particular microcommunities within them.

II. Only microassociations occurring on trees and stones are distinguished in biocoenoses, whereas those occurring on the soil and inhabiting the same substrate as the ground layer, shrubs and trees are considered together with the whole biocoenose.

III. All the microassociations occurring in the biocoenose are described as independent units. The macro- and microassociations distinguished are assumed as noncomparable to each other.

IV. All the plant layers are described as separate associations.

V. Two systems are introduced: one for biocoenoses, i.e. for the entire flora (epiphytes, fungi and soil fauna included), and the second for individual synusiae of plant layers, but separately for each layer.

From the standpoint of mutual ecological relations between the plant layers and synusiae Barkman suggests the classification of either entire phytocoenoses or, if possible, of biocoenoses with the exclusion of only the synusiae, which are not part of a complete ecosystem.

The role of macromycetes in communities of vascular plants and their phytosociological rank were also discussed by a number of authors (Höfler 1937, 1956; Favre 1948; Hueck 1953; Meisel-Jahn, Pirk 155; Pirk, Tüxen 1957; Jahn, Nespiak, Tüxen 1967; Nespiak 1959, 1968a and others). This problem is, however, complicated, since only fruit bodies of fungi are observed and conclusions concerning the qualitative and quantitative composition of the mycoflora are advanced on the basis of their periodical occurrence, whereas the main part of the fungus, the mymelium, is not taken into consideration here, owing to the difficulty of studies in this respect.

Opinions on the role of macromycetes in the structure of vascular plant communities may be divided into three main groups:

I. Macromycetes form synusiae, which constitute structural and functional elements of phytocoenoses and are characterized by a homogeneous life form. This opinion is respresented by: Leichner-Siska (1939), Ubrizsy (1943), Favre (1948), Kotlaba (1953), Nespiak (1959), Bohus, Babos (1960, 1967), Tomilin (1962), Lisiewska (1963, 1965, 1966).

Some phytosociologists, interested in the problem of the relation between fungi and vascular plant communities (Pirk 1948; Meisel--Jahn, Pirk 1955) advance the thesis, that fungi are equivalent components of the community and together with other plants form a mosaic of interpenetrating species.

II. Macromycetes form "dependent associations" (Braun-Blanquet 1951). The latter constitute intermediate groups between synusiae and autonomic associations and sometimes are referred to as "small associations" (Höfler 1956) connected with definite plant layers within "large associations".

III. Under certain ecological conditions fungi may form autonomic associations independent of the vascular plant association (Pirk, Tüxen 1957; Jahn, Nespiak, Tüxen 1967) or "mycocoenoses" (Kreisel 1961). A dynamic approach to these associations allows one to distinguish successive phases of fungi in dependence on the age and degree of decomposition of the substratum (Runge 1967, 1969; Jahn 1966). Jahn gave even names to these successsive phases derived from the indicator fungal species, e.g. *Phellinetum tremulae* — on trunks of living trees, *Crepidotetum calolepidis* — on dead logs.

Šmarda (1969) gave a review of mycocoenoses of deciduous forests of the western area of Moravia.

The following coclusions may be advanced on the basis of the opinions of the authors quoted above and the present author's own long-lasting observations.

Doubtless, the relations between macromycetes and a definite forest community are manifold. Fungi, being heterotrophic organisms are connected with the organic substratum in various ways. With live trees they form mycorrhizal connections or parasitise on them. They develop also on more or less decomposed forest litter and rotten wood as saprophytes. The development of many fungi depends on the quality of the substratum. In view of this it seems justified to accept the view of some mycologists (Haas 1932; Lange 1948), who claim, that the occurrence of a given fungal species in the forest community depends on the presence of certain tree species. On the other hand, there is a considerable group of fungi, which find optimum developmental conditions in definite forest communities. Doubtless, this is connected with the whole of the habitat conditions occurring in the phytocoenose, to which fungi exhibit a distinct reaction. Thus, fungi, as with the vascular plants, reflect all the factors conditioning the given habitat.

Fungi forming fruit bodies on the ground, i.e. mostly mycorrhizal fungi and saprophytes on decomposing plant and animal remains are most closely connected with a definite vascular plant community. These two groups, i.e. mycorrhizal and saprophytic fungi seem to form synusiae within the forest association.

Groups of xylophilous fungi should be treated in a somewhat different way. These fungi are more closely connected with the substratum and, as it was observed, exhibit a reaction to the degree of decomposition of wood, thus, together with other groups of cryptogams, they can be considered as components of dependent associations. Such communities (Kornaś 1966) have the character of units, that are to a certain degree distinctive both floristically and ecologically, but they are under a very strong influence of the higher vegetation which provides them with suitable phytoclimatic conditions. This is true particularly of fungi growing on rotten logs and stumps. Mycological observations seem to indicate, that the successive phases depending on the degree of wood decay cannot be considered as associations. It should be assumed rather, that one dependent association occurs, for instance on beach stumps in the beech forest association. If a name is to be given to this dependent association, the entire vegetation occurring on the stump should be taken into consideration. Changes in the species composition that accompany the various degrees of decay, can be interpreted as succeding phases of this association.

The methods applied in studies on macromycetes against the background of forest communities are closely similar to those commonly employed in phytosociology. Only modifications, indispensable in view of the different nature of fungi, were introduced. Nespiak (1958, 1959, 1968) gave a detailed review of the methods. Since in mycosociological studies we take into account only fruit bodies appearing periodically and exhibiting a higher intensity of occurrence every 3-4 years (Danilow 1949), most authors accept the view that only repeated observations, carried out on the same areas in the course of several years (optimally 3 years), give a picture of the qualitative composition and abundance of fungi occurring in the forest community.

Workers usually perform studies on 100 m² plots selected in both floristically and ecologically the most uniform patches of the forest community. Only a few workers (e.g. Lange 1948) carry out observations on 1-m² areas (in peat-bog associations) and others on 200, 400, 500, 1000-m² or even larger plots. Beside studies on permanent plots, some mycologists (e.g. Smickaya 1955, Kalmees 1968) also perform route analyses, which give, however, only orientational results.

The present studies were based on mycological studies carried out on possibly uniform patches of various beech forest communities in Western Pomerania and in Poznań Province several times during the vegetation season in the course of 2-3 years. Moreover, sporadic, comparative observations were made in the south-eastern part of Poland, as well as in Denmark (Islands of Fyn and Sjaelland) and in Yugoslavia (Serbia and Bosna). Studies, on which tables were based, concerned 400-m² permanent plots.

On the basis of the data obtained in respect of the substratum and abundance of fruiting macromycetes, synthetic tables for all the fungal species occurring in particular associations of the beech forests studied and summary tables for the compared forest associations were elaborated, beginning with the most fertile to the poorest patches of forests. Fungi are tabulated according to their ecological character: A — fructifying on the ground, B — fructifying on fallen leaves, fruits and other small remains of plants and animals, C — fructifying on wood. The following groups of fungi are distinguished in table C: a — fungi growing on twigs and branches, b — fungi growing on stumps and fallen logs in various stages of decomposition, c — fungi growing on trunks and roots of living and dying trees. The first figure in the synthetic tables (1, 2, 3) denotes the number of areas on which fruit bodies of the given fungal species were observed, the second — the number of all records on the areas observed, wheras the potential exponent indicates the abundance according to M o s e r's (1949) scale. The summary tables (4a, b, c) illustrate the ecological range of the most important fungal species of beech forests. Only these species are tabulated here, which, according to the author's observations and data from the literature, occur mainly in beech forests and may also pass into related forest associations, such as alder-elm, oak-hornbeam and pine-oak forests with a beech and fir contribution. The summary tables involve both the author's own studies and works of other investigators using analogous methods. Despite considerable divergencies in the number of observations on individual plots the materials summarized in Table 4 are comparable, since mycosociological studies were performed on plots with few records in the period of maximum appearance of fruit bodies, i.e. mostly from August to October inclusive. The Roman numerals (I-V) in the columns denote degrees of phytosociological constanty of individual species according to Braun-Blanquet, indicating the number of plots on the given area in the investigated forest community on which the given species fructified.

I	degree: —	1 - 20	per cent of all plots investigated
II	„	21 - 40	„ „ „ „ „ „
III	„	41 - 60	„ „ „ „ „ „
IV	„	61 - 80	„ „ „ „ „ „
V	„	81 - 100	„ „ „ „ „ „

These degrees of constancy were calculated only for species appearing in the area, on which more than 4 plots were established. When the number of plots was 1-4, the constancy was expressed by arabic numerals as follows:

+ —	single fruit bodies observed only once
1 —	the fungal species fruiting on one plot
2 —	„ „ „ „ „ two plots
3 —	„ „ „ „ „ three plots
4 —	„ „ „ „ „ four plots

Macromycetes reported from various European beech forest communities, which cannot be used for comparative purposes in Table 4, are summarized in Table 5. This Table presents the percentage of fungal species common for the *Melico-Fagetum* association in north-western Poland and for the compared beech forest communities.

The nomenclature of M o s e r (1967), supplemented according to

Lange (1935-1940), Damański, Orłoś, Skirgiełło (1967), Nikolayeva (1961), Corner (1950) and other authors was mainly used.

REVIEW OF PREVIOUS STUDIES ON MACROMYCETES OF BEECH FORESTS

There are many papers and contributions devoted to macromycetes of beech forests, but most of them are of a floristic character. The forest community is often veguely determined, e.g. beech-fir forest. Frequently the works give no precise determination of the substrate, from which the fruit bodies were collected, thus they could not be utilized for comparative purposes in the elaboration of macromycetes in strictly classified beech forest communities in Poland. Similarly, works devoted to the problem of mycotrophism of the beech could not be utilized here.

The first works on macromycetes in beech forest communities applying phytosociological methods were published in the thirties of this century. They were initiated by Höfler (1937), who made a number of phytosociological records of fungi in beech forests of the Wiener Wald and by Leischner-Siska (1939) who studied fungi in *Fagetum praealpinum* on calcareous areas near Salzburg. Further, Friedrich (1940) pointed out the influence of ecological conditions (humidity, temperature, light, wind, soil) on the fructification of fungi in beech forests in the environs of Vienna. Kreisel (1957a), considering the mycoflora of various plant communities of the Darss Peninsula, listed a number of fungal species collected in beech-oak forest belonging probably to the *Fago-Quercetum* association. The same author also presented a list of fungi from fertile beech forests growing on the chalk cliff of Rügen Island (Kreisel 1957b). The latter work, however, is of floristic character. As regards Germany, we also dispose of the work of Jahn, Nespiak and Tüxen (1967) performed in beech forests (*Carici-Fagetum*, *Melico-Fagetum* and *Luzulo-Fagetum*) of the Wesergebirge. Groups of fungi characterizing and distinguishing beech forest associations as well as accompanying species were separately drawn up in a table. The works concerning various forest communities in Hungary (Bohus and Babos 1960, 1967; Ubrizsy 1966) belong to important publications of phytosociological character. The Hungarian authors carried out observations on permanent plots, among others also in beech and beech-oak forest communities and pointed out characteristic and predominating species. Pilát (1969) in his studies on fungi of various plant communities of Czechoslovakia took into consideration also mountain and lowland beech forests. His work is not based solely on his own observations, for he also quotes the results of studies of other Czech mycologists, thus he presents the problem of biology, sociology and ecology of macromycetes of the entire territory of Czechoslovakia.

In Poland, studies on the mycoflora of beech forest associations were performed in the first place in mountain forest formerly classified as the *Fagetum carpaticum* association. During a Single year Wojewoda (1960) carried out mainly floristic-phenological observations in the central part of the Cracow—Częstochowa upland. Gumińska (1962b) made observations over several years on the same area and in the Beskid Sądecki Mts. on several permanent plots in the associations *Dentario enneaphyllidis-Fagetum*, *Dentario glandulosae-Fagetum* and *Luzulo-Fagetum*, with reference in the first place to the ecology and biology of fungi of the beech forests. Though this author did not employ the abundance scale of fructifying fungi according to Moser, the results may be

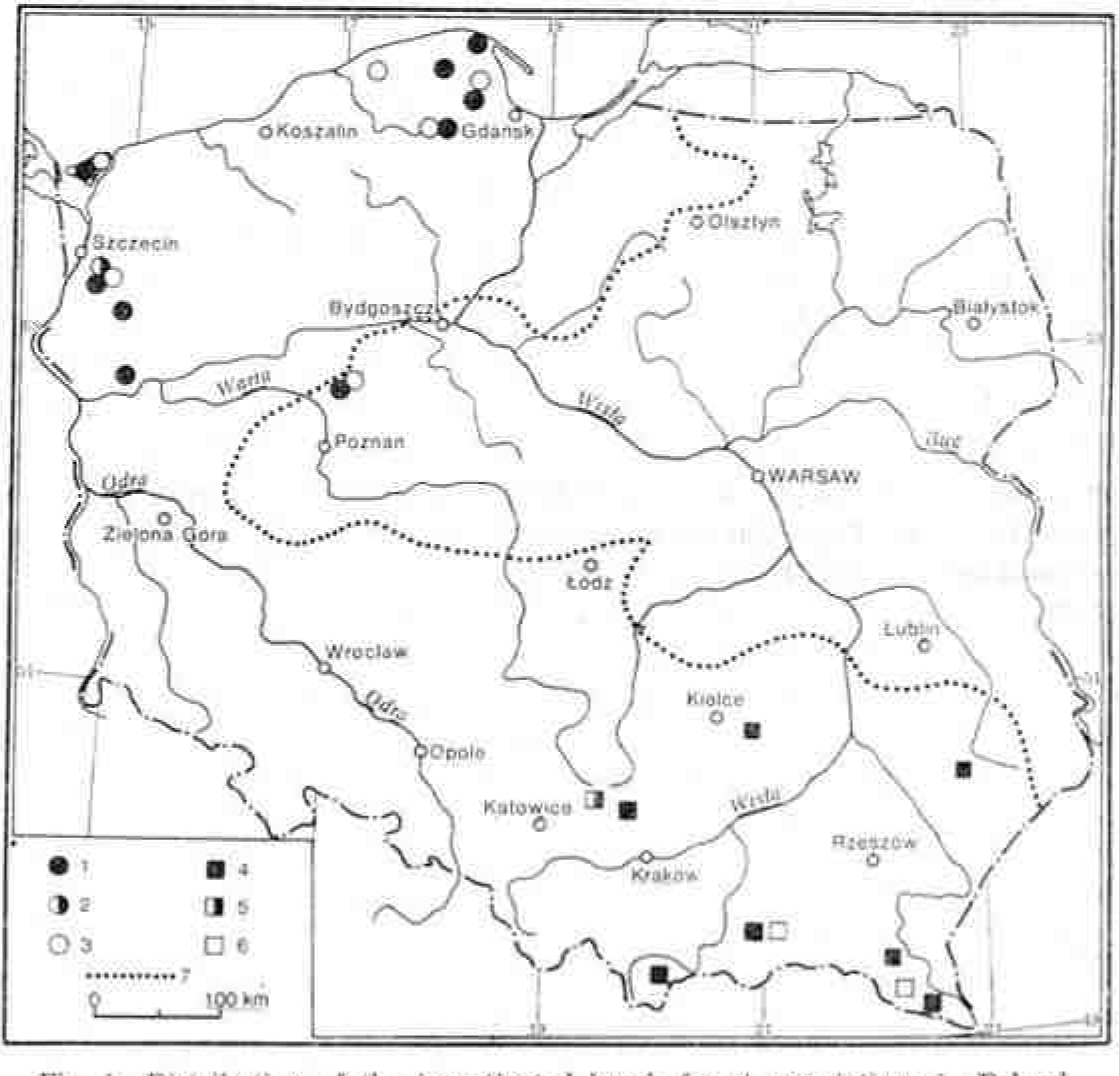

Fig. 1. Distribution of the investigated beech forest associations in Poland
1 — *Melico-Fagetum;* 2 — *Mercuriali-Fagetum;* 3 — acidophilous beech and beech-oak forests; 4 — *Dentario glandulosae-Fagetum;* 5 — *Dentario enneaphylidis-Fagetum;* 6 — *Luzulo-Fagetum;* 7 — eastern distribution limit of beech in Poland

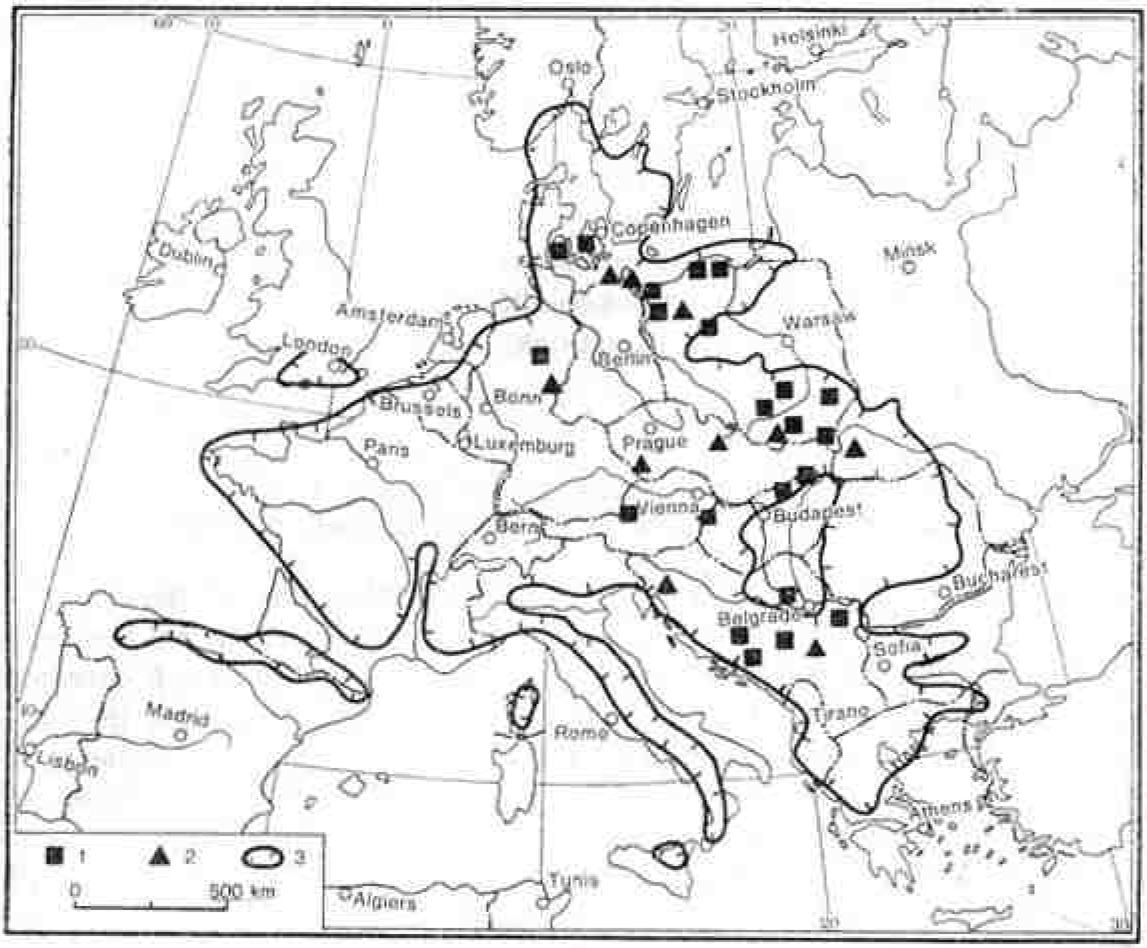

Fig. 2. Localities where macromycetes of beech forests in Europe were investigated 1 — mycosociological research on permanent plots; 2 — floristic observations; 3 — distributional limit of beech in Europe

utilized for comparative purposes, since the plots were established on patches of communities, the phytosociological classification of which is beyond doubt. At the same time, a group of mycologists carried out investigations on the mycoflora of Western Bieszczady Mts. (D o m a ń s k i et al. 1960, 1963, 1967, 1970) and made ample lists of fungal species recorded also in beech forests (*Dentario glandulosae-Fagetum* and *Luzulo-Fagetum*), which occupy the major area of the Bieszczady Mts. In addition, the following reports concerning mountain beech forest associatione were published: W o j e w o d a (1964, 1965) on the Gorce Mts. and Babia Góra Mt., G u m i ń s k a (1962a, 1969) on the Beskid Sądecki and Pieniny Mts. and results of studies performed in the Świętokrzyski National Park (L i s i e w s k a 1966b). Recently, W o j e w o d a (1971) published a work on the contribution of macromycetes to plant communities of the Ojców National Park and S a ł a t a (1972) on beech and fir forests of Central Roztocze.

Analogous researches on lowland beech forests were undertaken by the present author in the *Melico-Fagetum* association in several reservations of the Beech Forest near Szczecin (L i s i e w s k a 1960). The author continued these studies in the course of the subsequent years on 14 permanent plots on patches of various beech forest communities, taking into consideration the degres of attachment of particular fungal species to forest associations in dependence on habitat conditions and the floristic composition (L i s i e w s k a 1963). Similar investigations were carried out in the beech and beech-oak forests in the Wolin Island National Park.

CONTRIBUTION OF MACROMYCETES TO BEECH AND BEECH-OAK FOREST COMMUNITIES IN NORTH-WESTERN POLAND

The Polish phytosociological literature includes several papers concerning beech forest communities. Many of them refer to studies performed in well developed beech communities, e.g. in Western Pomerania (C e l i ń s k i 1962; P i o t r o w s k a 1966 and others). However, the opinions of various authors are not completely consistant, particularly as regards the classification of patches of acidophilous communities of beech and beech-oak forests occurring on similar habitats.

Apart from the preliminary systematic-phytosociological work of A. M a t u s z e w i c z (1958), there are no further synthetic publications giving a detailed characteristic of beech forests in Poland. We only consider the systematic publication of plant communities in Poland comprising higher phytosociological units to associations inclusively (W. M a t u s z k i e w i c z 1967).

The phytosociological characteristic of the beech forest studied, and particularly the distinction of units lower than associations, was based on a number of works (C e l i ń s k i 1962; P i o t r o w s k a, Ż u k o w s k i 1967; partly W. M a t u s z k i e w i c z and A. M a t u s z k i e w i c z 1970).

The best preserved patches of beech forest communities of north-western Poland are found in the Beech Forest near Szczecin. Owing to the wide differentiation of habitats a number of communities of deciduos forests with a predominance of beech occur here. These communities have been elaborated from the phytosociological standpoint by C e l i ń s k i (1962) and the present author accepted his classification as a basis in her research on macromycetes.

1. *Mercuriali-Fagetum* Cel. 1962 — humid fertile beech forest

This beech wood classified to the suballiance *Cephalanthero-Fagion* Tx. 1955 involving fertile, calciphilous, orchid beech forests (W. M atuszkiewicz 1967; W. Matuszkiewicz and. A. Matuszkiewicz 1970). From the ecological standpoint this association is the most humid community of the alliance *Fagion* (Celiński 1962). Patches of this association occupy relatively small areas and so far has been identified only in the Beech Forest near Szczecin. *Mercuriali-Fagetum* occupies the most fertile habitats in gully depressions in the terminal moraine zone, on soils of the black earth type with a high ground water level (about 90 cm). Owing to the high $CaCO_3$ content the soil reaction is basic and in the superficial layers it ascillates within the limits of pH 7-8.

Beech dominates in the dense tree layer, but single pedunculate oaks, ashes and black alders occur. The shrub layer is generally absent, whereas the field layer is well developed and rich in eutrophic species connected with fertile and humid soils (Celiński 1962). The most abundant plant is dog's mercury (*Mercurialis perennis*).

Mycological studies were performed in this association on three permanent plots (Lisiewska 1963). A total number of 88 fungal species were found, of which one half are terrestrial fungi (Table 1). Among them, there occurred species, for which fertile, humus and humid soils constitute optimal conditions, e.g. *Lyophyllum connatum* fructifying on a very humid soil, *Lepiota hetieriana* rare in beech forests (J. Lange 1935-1940; Moser 1967) as well as *Galera tenera* f. *minor*, *Tubaria minutalis* and *Laccaria tortilis* most frequently observed on bare humid soil. Some species of fungi accompanying black alder, such as *Naucoria subsonspersa* and *N. scolecina* were also collected. The quoted species, characterize perfectly the discussed beech forest association and confirm its specific character, particularly as regards habitat conditions, separating it from other beech forest communities in Western Pomerania. On the other hand, a number of fungal species common in various beech forest communities, such as *Lactarius blennius*, *Hygrophorus eburneus*, *Russula cyanoxantha*, *Marasmius recubans* and *Dasyscyphus virgineus*, were also observed in the *Mercuriali-Fagetum* association.

Of the group of xylophilous fungi, the following two species, characteristic of beech forests: *Mycena crocata* and *Marasmius alliaceus* are noteworthy. In the association discussed, they exhibited relatively numerous fruit bodies on rotting beech twigs. In addition on the fallen beech twigs in all the studied patches of *Mercuriali-Fagetum* the presence of fruit bodies of *Hydropus subalpinus* was noted. This species was observed almost exclusively in beech forests of north-western Poland and Denmark (Lange, Lisiewska 1969). Fungi developing on rotten stumps and logs constituted a small group (Table 1). A lack of representatives of the family *Polyporaceae* is noticeable; species of the order *Agaricales* and some *Ascomycetes* were dominant there. From the standpoint of successive stages of the association of xylophilous fungi,

Table 1
Macromycetes recorded in the Mercuriali-Fagetum association

Locality		Puszcza Bukowa
Number of plots		3
Number of observations on the plots		21
Number of species	A	47
	B	12
	C	29
A. Terrestrial fungi		
Laccaria amethystina		$3/3^{+-2}$
Galera tenera f.minor ss.Lange		$2/3^{+-1}$
Laccaria laccata		$2/3^{+-1}$
Collybia dryophila		$2/3^{+-1}$
Inocybe geophylla var.violacea		$2/2^{1-2}$
Lepiota seminuda f.minima ss.Lange		$2/2^{1}$
Peziza badia		$2/2^{1}$
Humaria hemisphaerica		$2/2^{+-1}$
Clitocybe infundibuliformis		$2/2^{+-1}$
Lepiota pseudo-felina		$2/2^{+-1}$
Lyophyllum connatum		$2/2^{2}$
Coprinus silvaticus		$1/2^{2}$
Naucoria subconspersa		$1/2^{1-2}$
Mycena pura		$1/2^{1}$
Coprinus ephemerus		$1/2^{1}$
Hygrophorus eburneus		$1/2^{1}$
Naucoria scolecina		$1/2^{2}$
Tubaria minutalis		$1/2^{1}$
Laccaria tortilis		$1/1^{2}$
Coprinus atramentarius		$1/1^{2}$
Clavulina cinerea		$1/1^{2}$
Cantharellus cinereus		$1/1^{1}$
Russula cyanoxantha		$1/1^{1}$
Psathyrella gracilis		$1/1^{1}$
Lepiota hetieriana		$1/1^{1}$
Cyathipodia macropus		$1/1^{1}$
Lepiota cristata		$1/1^{1}$
Pholiotina mairei		$1/1^{1}$
Inocybe umbrina		$1/1^{1}$
Leotia lubrica		$1/1^{1}$
Tricholoma sulphureum		$1/1^{1}$
Russula fellea		$1/1^{1}$
Psathyrella atomata		$1/1^{1}$
Lactarius volemus		$1/1^{1}$
Galera teneroides ss.Lange		$1/1^{1}$
Rhodophyllus juncinus		$1/1^{1}$
Inocybe bongardii		$1/1^{+}$
Inocybe incarnata		$1/1^{+}$
Amanita vaginata		$1/1^{+}$
Inocybe scabra		$1/1^{+}$
Inocybe auricoma		$1/1^{+}$
Inocybe gausapata		$1/1^{+}$
Inocybe fastigiata		$1/1^{+}$
Paxina acetabulum		$1/1^{+}$
Lactarius blennius		$1/1^{+}$
Coprinus xanthothrix		$1/1^{+}$
Galera tenera f.tenera ss. Lange		$1/1^{+}$

B. Fungi on fallen leaves and fruits	
Marasmius recubans	$3/3^{1-2}$
Mycena galopoda	$2/2^{+-1}$
Clitocybe fragrans	$1/2^{1}$
Clitocybe odora	$1/2^{1}$
Marasmius bulliardii	$1/2^{1}$
Cordyceps militaris	$1/2^{+}$
Dasyscyphus virgineus	$1/1^{3}$
Collybia cookei	$1/1^{2}$
Collybia peronata	$1/1^{1}$
Marasmius lupuletorum	$1/1^{1}$
Marasmius cohaerens	$1/1^{1}$
Psathyrella prona	$1/1^{+}$
C. Xylophilous fungi	
a/ on fallen twigs and branches	
Marasmius alliaceus var.alliaceus	$3/13^{1-2}$
Marasmius alliaceus var.subtilis	$3/9^{1-2}$
Marasmius rotula	$3/9^{1-2}$
Polyporus varius var.nummularius	$3/7^{+-1}$
Mycena acicula	$3/3^{+}$
Mycena crocata	$2/8^{1-2}$
Crepidotus lundellii	$2/5^{2}$
Mycena filopes	$2/5^{+-1}$
Hydropus subalpinus	$2/3^{+-1}$
Mycena vitilis	$2/3^{+-1}$
Cyathus striatus	$1/1^{2}$
Ramaria stricta	$1/1^{2}$
Resupinatus silvanus	$1/1^{2}$
Psathyrella obtusata	$1/1^{+}$
b/ on stumps and logs	
Mycena galericulata	$3/4^{1}$
Scutellinia scutellata	$3/4^{1}$
Oudemansiella platyphylla	$2/7^{+-1}$
Kuehneromyces mutabilis	$2/2^{2}$
Xylosphaera polymorpha	$2/X^{2}$
Mycena haematopoda	$1/2^{2}$
Pluteus cervinus ss.Lange	$1/2^{+-1}$
Xylosphaera hypoxylon	$1/X^{2}$
Mycena inclinata	$1/1^{2}$
Psathyrella leucotephra	$1/1^{2}$
Mycena polygramma	$1/1^{1}$
Chlorosplenium aeruginosum	$1/1^{1}$
Gerronema fibula	$1/1^{1}$
Mycena olida	$1/1^{1}$
c/ on trunks and roots	
Oudemansiella radicata	$3/4^{1}$
Oudemansiella mucida	$1/1^{1}$

most species observed on rotten stumps (*Kuehneromyces mutabilis, Xylosphaera polymorpha* and *X. hypoxylon*) could be classified to the group distinguishing the terminal phase according to Kreisel (1961).

2. *Melico-Fagetum* Lohm. ap. Seibert 1954 — fertile lowland beech forest

The fertile lowland beech forest, known also as the Pomeranian beech forest, belongs to the suballiance *Eu-Fagion* Oberd. 1957 em. Tx. 1960, which comprises meso- and eutrophic beech forests on soils rich in nutrient components with humus of mull or moder-mull type.

Typical patches of the *Melico-Fagetum* association occur in the western and central part of the area known as the Pomerania stage of the Baltic glaciation, whereas less typical patches are observed in the western part of Poland, within the range of the central Polish glaciation (W. Matuszkiewicz and A. Matuszkiewicz (1970). This association is connected with the Subatlantic climate characterized by a small annual amplitude of temperatures, mild winter and humid, relatively cool summer.

It occurs on slopes of the terminal moraine hills most frequently on loam and sandy-loam brown earth.

Within the *Melico-Fagetum* association various authors distinguish lower phytosociological units, such as subassociations, variants or facies, dependent upon the local edaphic factors and floristic composition.

a) *Melico-Fagetum cephalantheretosum rubrae*

Patches of the orchid subassociation of *Melico-Fagetum* form a narrow belt (100-200 m wide) running along the plateau over the coastal cliff in the Wolin Island National Park. They develop under different microclimatic and soil conditions than those of the beech forest patches classified to the typical subassociation. The community discussed occurs on the most fertile brown soils of Wolin Island. The soil surface as well as the plants of the field layer are constantly covered with sand blown from the beach and marl dust from the cliff slopes. Owing to the wind, a loose, sandy-humus, about 60 cm thick, accumulation level develops (Piotrowska 1966). The soil reaction of the superficial layers within the zone of occurrence of mycelia is almost neutral (pH 7.0-7.5).

The specific habitat conditions occurring on the sea coast influence the floristic composition of this orchid subassociation. The tree stand consists mainly of beech, whereas pedunculate oaks constituting a slight admixture grow beyond the area studied. The beech forms also a loose shrub layer and appears in the form of seedlings. In the field layer, beside species of the order *Fagetalia*, abundant orchids are noteworthy. Here belong *Cephalanthera rubra*, *C. Damasonium*, *Corallorhiza trifida*, *Listera ovata*, *Platanthera bifolia* and others, which distinguish the subassociation studied. Nearer to the cliff a higher agglomeration of xerothermic plants is observed (Piotrowska 1966). A considerable contribution of *Bryophyta* is also noteworthy (Lisowski 1961; Szweykowski, Koźlicka 1966).

Mycological studies were carried out on a single plot (Lisiewska 1966a), on which 36 terrestial fungi, 12 on fallen leaves and 28 xylophilous species were found.

Similarly as in vascular plants and *Bryophyta*, certain differences are observed in macromycetes between the orchid subassociation and the typical one distinguished in the Wolin Island National Park and other parts of Western Pomerania.

Within the synusiae of terrestrial fungi and among those fructifying on plant remnants, calciphilous fungi (e.g. *Russula maculata* and *Cortinarius largus*) are noteworthy. Several species belonging to the genus *Inocybe*, such as *I. dulcamara* occurring on sandy soils as well as *I. bongardii*, *I. abjecta* and *I. fastigiata* reported mainly from beech forests (J. Lange 1935-1940) were found exclusively in the subassociation *Melico-Fagetum cephalantheretosum rubrae*. On the other hand, a number of species frequently occurring in other *Melico-Fagetum* subassociations, on less fertile soils with a more acidophilous reaction, were not observed here. These are, for instance *Lactarius blennius*, *L. subdulcis*, *Craterellus cornucopioides*, *Bolatus edulis*, *Russula veternosa*, *R. ochroleuca* and *Tricholoma ustale*.

Old, wind-bent beeches, growing on the cliff edge, constitute a particularly interesting habitat. Their trunks and particularly their bases are covered with a thick sand-drift and marl dust. Communities of mosses and liverworts, among which both epiphytic and euritopic terrestrial species occur, (Lisowski 1961, Szweykowski, Koźlicka 1966) appear on this specific substrate. The floristic list of this community, in which *Bryophyta* predominate, may be supplemented by several macromycetes species, such as: *Galerina hypnorum*, *G. embolus*, *Gerronoma fibula* and *Rhodophyllus rhodocylix*. This community should be treated as a dependent association.

On the trunks of live beeches, on cortex free of the sand-drift, *Oudemansiella mucida* fructified in great numbers and *Polyporus squamosus* less abundantly, whereas fruit bodies of *Oudemansiella radicata* occurred on roots in small quantity.

Macromycetes characteristic of beech forests, such as: *Marasmius alliaceus* var. *alliaceus* and var. *subtilis*, *Mycena crocata*, *Polyporus forquignoni* and several other fungi common in beech and oak-hornbeam forest communities, e.g. *Polyporus varius*, *P. brumalis* and *Mycena vitilis* were found on fallen beech branches. Fungi growing on rotten beech stumps and logs (Table 2c) constituted a relatively small group and this is attributable to the less frequent occurrence of this substrate in the studied plot of the orchid beech forest.

Table 2a
Macromycetes recorded in the Melico-Fagetum association
A. Terrestrial fungi

Subassociation	ceph. rubrae	typicum									festucet. silvat.		cala-ma-grost.
Locality	Wol. Park Narod.	Rozo-wie	Pusz-cza Bukowa	Gnie-wowo	Dzi-czy Las	Kąty	Wol. Park Nar.	Zam-kowa Góra	Bog-da-niec	Roze-wie	Pusz-cza Bukowa	Zam-kowa Góra	Boże pole
Number of plots	1	1	6	3	2	5	3	1	3	1	3	1	1
Number of observations on the plots	6	6	33	10	6	23	18	7	25	6	21	7	6
Number of species	36	13	53	28	15	50	47	33	46	29	30	31	24
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Collybia dryophila	$1/3^{1}$	$1/2^{1-2}$	$3/6^{1-2}$	$3/6^{1-2}$	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	$1/2^{1-2}$	$3/15^{1-2}$	$1/1^{2}$	$1/1^{2}$	$1/3^{2}$	$1/2^{1}$
Hygrophorus eburneus	.	$1/1^{1}$	$2/3^{+-1}$	$1/1^{2}$	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	$3/7^{1-2}$	$1/1^{2}$	$3/3^{1}$	$1/1^{1}$	.
Russula mairei	$1/2^{1}$	.	$3/3^{1}$	$1/1^{2}$	$1/1^{1}$	$2/2^{+-1}$	$3/4^{1}$	$1/1^{1}$	$1/1^{2}$	.	$2/4^{1}$	$1/2^{2}$	$1/2^{2}$
Russula cyanoxantha f. cyanoxantha	$1/4^{1}$	$1/2^{1}$	$5/11^{+-2}$	$1/2^{1}$	$2/2^{1}$	$1/1^{1}$	$3/5^{1}$	$1/1^{1}$	$3/5^{+-1}$	$1/2^{1}$	$2/3^{1}$	.	$1/2^{1}$
Russula fellea	$1/3^{1}$	.	$4/4^{+-1}$	$2/2^{1}$	.	$2/2^{1}$	$1/1^{1}$	$1/2^{1}$	$1/3^{1}$	$1/1^{1}$	.	$1/2^{2}$	$1/1^{2}$
Amanita rubescens	$1/2^{1}$	.	$3/3^{1}$	.	.	$2/2^{1}$	$1/2^{1}$	.	$2/9^{1}$	.	$2/5^{1}$	$1/1^{1}$	$1/2^{1}$
Amanita citrina	$1/2^{1}$	$1/1^{1}$	$4/6^{+-1}$	.	.	$4/5^{+-1}$	$1/2^{1}$	$1/1^{1}$	$2/3^{+-1}$	.	$3/9^{1}$	$1/2^{1}$	$1/3^{2}$
Stropharia aeruginosa	$1/1^{1}$	.	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	$2/4^{1}$	$2/2^{1}$	.	$2/7^{1}$	.	.	$1/2^{1}$	.
Russula lutea	$1/1^{+}$	.	$1/1^{+}$	.	.	$3/3^{+-1}$	$2/2^{1}$	$1/1^{1}$	$2/4^{1}$	.	$2/3^{1}$	.	.
Hydnum repandum	$1/1^{1}$	.	.	$1/1^{2}$	.	$1/1^{1}$	$2/2^{1}$	.	.	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	.
Phallus impudicus	$1/1^{1}$	.	$4/6^{1-2}$	.	$1/1^{1}$	$1/1^{1}$	$3/5^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/2^{2}$	.	.
Boletus erythropus	$1/1^{1}$	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.	.	.	$2/2^{1}$	.	$1/1^{2}$
Aleuria aurantia	$1/1^{2}$	.	$1/2^{2-3}_{1}$	.	.	$1/1^{1}$	.	.	.	.	$1/1^{2}$	.	.
Laccaria amethystina	.	.	$3/3^{1-2}$	$2/3^{1}$	.	$3/8^{1-2}$	$3/3^{1}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	$3/4^{1-2}$	$1/3^{1}$	$1/1^{2}$
Laccaria laccata	.	.	$4/6^{1-2}$	$2/3^{1}$	.	$4/1^{+-1}$	$1/1^{1}$	$1/1^{1}$	$2/4^{1}$	.	$3/4^{2}$	$1/2^{1}$	.
Lactarius blennius	.	.	$3/4^{1}$	$2/2^{1}$	$2/2^{1}$	$2/3^{1}$	$1/1^{1}$	$1/2^{1}$	$2/2^{1}$	$1/1^{1}$	$3/4^{1-2}$	$1/1^{1}$	$1/1^{2}$
Lycoperdon perlatum	.	.	$3/4^{1}$	$1/1^{1}$	.	$4/8^{1}$	$3/3^{1}$	$1/1^{1}$	$1/1^{1}$	.	$3/6^{1}$	$2/2^{1}$	$1/1^{1}$
Boletus edulis	.	.	$2/3^{1}$	$1/1^{1}$	.	$1/3^{1}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$2/4^{1}$	$1/1^{1}$	$1/1^{1}$
Xerocomus chrysenteron	.	.	.	$3/3^{1-2}$	$1/1^{1}$	$5/8^{+-1}$	$2/3^{1}$	$1/2^{1-2}$	.	$1/1^{1}$	.	$1/1^{2}$	$1/3^{1}$
Craterellus cornucopioides	.	.	$2/3^{2}$	$1/1^{3}$	.	$2/6^{2-5}$	$1/2^{1}$	$1/1^{3}$	.	.	$3/5^{2}$	$1/2^{2-5}$	.
Xerocomus subtomentosus	.	.	$2/4^{1}$	.	.	.	$3/3^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/3^{1}$	$1/1^{1}$	.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lactarius vellereus	.	.	.	$2/2^{1}$	.	.	$1/2^{1}$	$1/3^{2}$	.	$1/1^{1}$	$2/1^{2}$	$1/1^{2}$	$1/1^{2}$
Mycena pura f. pura	.	.	$5/1^{+-2}$	$1/1^{1}$	.	$1/3^{+-1}$	$3/6^{1}$	.	.	$1/1^{1}$	$1/1^{1}$	$1/2^{1}$	$1/1^{1}$
Lactarius subdulcis	.	.	$1/1^{2}$	.	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	$1/2^{+-1}$	$1/2^{1}$	.	.	$1/1^{1}$	$1/1^{1}$
Agrocybe praecox	.	.	$2/2^{+}$	$2/2^{1}$	.	.	.	$1/1^{1}$	.	$1/1^{1}$	$1/1^{2}$	.	$1/1^{1}$
Russula nigricans	.	.	$1/1^{1}$	.	.	$4/9^{1}$	.	$1/1^{1}$	$2/3^{1}$	.	.	.	.
Lactarius piperatus	.	.	$1/2^{1-2}$	.	$1/1^{1}$	.	$2/2^{1}$	.	$1/3^{1-2}$	.	$2/4^{1}$	.	.
Russula cyanoxantha f.atroviolacea ss.Lange	.	.	$1/1^{1}$	.	.	$2/2^{1}$	.	.	.	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$
Cortinarius flexipes	.	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.	.	$1/1^{2}$
Inocybe geophylla	.	.	$1/1^{1}$	.	.	.	.	.	.	$1/1^{1}$	$1/2^{+}$	$1/1^{1}$	.
Russula veternosa	.	.	.	$2/2^{1}$	.	$1/1^{1}$	$3/3^{1}$	.	.	.	.	$1/1^{1}$	.
Russula olivacea	.	.	$2/2^{1}$	.	.	.	$1/1^{1}$	.	.	.	$1/3^{+}$	.	.
Hebeloma crustuliniforme	.	.	.	$1/1^{1}$	.	.	.	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	.
Tricholoma sulphureum	.	.	$3/5^{1}$	$1/1^{2}$	.	.	.	.	$1/2^{1-2}$	.	$1/1^{1}$	$1/1^{1}$	.
Tricholoma ustale	.	.	$1/1^{1}$	.	.	.	$1/1^{1}$	.	$1/1^{1}$	.	$2/2^{1}$	.	.
Russula ochroleuca	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	$2/3^{1}$	.	$1/1^{1}$		.
Psathyrella gracilis	$1/1^{2}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	.	.	.	$1/2^{1}$	.	.	.
Clitocybe infundibuliformis	$1/2^{1}$	.	.	.	.	$1/1^{+}$	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/2^{1}$	.	.	.
Russula delica	$1/2^{1}$	.	.	.	.	.	.	$1/1^{1}$	$3/7^{+-1}$	$1/1^{1}$	.	.	.
Coprinus picaceus	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/1^{1}$	$4/14^{1-2}$	.	$1/1^{1}$	$1/1^{1}$	.	.	.	.
Agaricus silvicola	$1/1^{1}$	.	$1/3^{+-1}$	.	.	$1/1^{+}$	.	.	$1/1^{2}$	.	.	.	.
Russula chamaeleontina	$1/2^{1}$	.	$1/1^{+}$	.	.	$1/1^{1}$	$3/5^{1}$	.	.	.	.	.	.
Russula fragilis	$1/1^{1}$	.	. .	.	.	.	$1/1^{1}$	.	$1/3^{1}$	.	.	.	.
Helvella crispa	$1/1^{1}$	.	.	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	.	.	$1/1^{1}$	.	.	.	.
Boletus luridus	$1/2^{1}$	.	$1/2^{1}$	.	.	$1/1^{+}$	$1/1^{1}$	.	.	.	.	.	.
Humaria hemisphaerica	$1/1^{1}$	.	$1/1^{2}$	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.
Russula mazulata	$1/3^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Coprinus largus	$1/2^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Inocybe dulcamara	$1/2^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Inocybe bongardii	$1/1^{2}$	.	.	.	.	.	.	.	.	.	.	.	.
Lepiota cristata	$1/1^{2}$	.	.	.	.	.	.	.	.	.	.	.	.
Inocybe eutheles	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Inocybe fastigiata	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.
Lepiota naucina	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Paxina acetabulum	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Amanita pantherina	$1/1^{1}$	f .	.	.	.	.	.	.	.	.	.	.	.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lepista acutesquamosa	1/1*	.	.	.	.	.	.	.	.	.	.	.	.
Otidea alutacea	1/1*	.	.	.	.	.	.	.	.	.	.	.	.
Peziza succosa	.	$1/2^{2}$	.	.	.	.	.	.	.	.	.	.	.
Leptopodia pezizoides	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.
Clavulina cinerea	.	$1/1^{2}$	$2/2^{1}$	.	.	.	.	.	.	.	.	.	.
Amanita spissa	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Inocybe asterospora	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Boletus appendiculatus	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Tubaria minutalis	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Peziza badia	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Otidea onotica	.	.	$1/1^{2}$	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Leotia lubrica	.	.	$1/2^{1-2}$	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Strobilomyces floccopus	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	$1/2^{1}$	.	.	.	.	.
Clavulina cristata	.	.	$2/2^{1}$	$1/1^{1}$	.	.	$1/2^{1}$	.	.	.	.	.	.
Scleroderma verrucosum	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	$1/2^{1}$	.	.	.	.
Amanita vaginata	.	.	$1/1^{1}$	.	.	.	.	.	$1/1^{1}$	.	.	.	.
Russula laurocerasi	.	.	$1/1^{1}$	.	.	$1/1^{1}$	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.
Tricholoma lascivum	.	.	$1/1^{1}$	.	.	..	.	.	$1/1^{1}$	.	.	.	.
Lactarius pyrogalus	.	.	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Amanita phalloides	.	.	$2/2^{1}$	.	.	.	$1/1^{1}$	.	$1/1^{1}$	.	.	.	.
Russula virescens	.	.	$1/1^{1}$	.	.	.	.	.	$2/5^{1}$	.	.	.	.
Clitocybe nebularis	.	.	.	$1/1^{1}$	.	$2/2^{1}$	$2/3^{1}$	.	$2/3^{1}$	.	.	.	.
Galera tenera f. tenella ss. Lange	.	.	.	$1/1^{1}$	.	$1/1^{1}$	.	$1/1^{1}$	.	.	.	.	.
Stropharia squamosa	.	.	.	$2/2^{1}$	.	$2/2^{1}$	$1/1^{1}$	$1/2^{1-3}$	$1/4^{1}$	$1/1^{2}$	.	.	.
Coprinus silvaticus	.	.	.	.	$1/1^{1}$	.	.	.	..	.	.	.	.
Coprinus xanthothrix	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.
Rhodophyllus juncinus	.	1/1*	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.	.
Lepista nuda	.	.	.	.	.	$2/3^{1}$	.	.	$3/3^{1}$	.	.	.	.
Russula solaris	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.	.
Russula grisea var. xanthochlora	.	.	.	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.
Lactarius pallidus	.	.	.	.	.	$1/1^{1}$	.	$1/1^{1}$	$2/3^{1}$	.	.	.	.
Russula lepida	.	.	.	.	.	$1/1^{1}$	.	.	$2/3^{1}$	.	.	$1/1^{1}$	.
Lepiota clypeolaria	.	.	.	.	.	3/3*	.	.	.	.	$1/1^{1}$	.	.
Lepiota tomentella	.	.	.	.	.	$1/1^{2}$	.	.	.	.	.	.	.
Otidea cochleata	.	.	.	.	.	$1/4^{1-3}$	.	.	.	.	.	.	.
Inocybe napipes	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.
Russula farinipes	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Russula curtipes	.	.	.	.	.	$1/1^{+}$	.	.	.	.	.	.	.
Coprinus lagopus	.	.	.	.	.	$1/1^{+}$	.	.	.	.	.	.	.
Cystoderma amiantinum	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.
Russula alutacea	.	.	.	.	.	.	$1/3^{1}$	.	.	.	$1/1^{1}$	.	$1/1^{1}$
Lepiota seminuda f. minima ss. Lange	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Hygrophorus leucophaeus	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Mycena pura f. rosea ss. Lange	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Gyroporus cyanescens	.	.	.	.	.	.	$1/2^{1}$	.	$1/1^{1}$	.	.	.	.
Rhodophyllus nidorosus	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.
Cortinarius decipiens	.	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.
Cortinarius mucifluus	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Phaeomarasmius granulosus	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Lactarius fuliginosus	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Russula versicolor	.	.	.	.	.	.	.	.	$2/2^{1}$	.	.	.	.
Tricholoma columbetta	.	.	.	.	.	.	.	.	$3/4^{1}$	.	$1/1^{1}$	.	.
Hygrophorus cossus	.	.	.	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.	.
Hebeloma longicaudum	.	.	.	.	.	.	.	.	$3/2^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/2^{1}$
Clavariadelphus pistillaris	.	.	.	.	.	.	.	.	.	$1/1^{2}$	$1/1^{2}$	.	.
Inocybe auricoma	$1/1^{1}$	.	.	.	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.	.
Clitopilus prunulus	.	$1/1^{1}$	.	.	.	.	.	.	.	$1/1^{2}$	.	.	.
Inocybe griseo-lilacina	.	$1/1^{*}$	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.
Russula integra	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.
Clitocybe cerussata	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.
Russula vesca	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.
Cortinarius decoloratus	.	.	.	.	.	.	.	.	.	$1/1^{*}$	.	$1/1^{1}$	.
Cantharellus cibarius	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.	$2/3^{1}$	.	.
Russula atropurpurea	.	.	$1/1^{1}$	.	.	.	.	.	.	.	$2/3^{1-2}$	.	.
Lepiota pseudo-felina	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.
Tricholoma terreum	.	.	.	.	.	.	.	.	.	.	$1/1^{2}$	.	.
Cortinarius alboviolaceus	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$	$1/1^{1}$	.
Clitocybe clavipes	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.
Cortinarius pumilus	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.
Psathyrella velutina	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.
Agrocybe aegerita	.	.	.	.	.	.	.	.	.	.	.	.	$1/3^{2}$
Rhodophyllus griseorubellus	.	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$
Cantharellus tubaeformis	.	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$
Cortinarius pseudosalor	.	.	.	.	.	.	.	.	.	.	.	.	$1/1^{*}$

Table 2b

Macromycetes recorded in the Melico-Fagetum association

B. Fungi on fallen leaves and fruits

Subassociation	ceph. rubrae	typicum									festucet. silvat.		cala-ma-grost.
Locality	Wol. Park Nar.	Roze-wie	Pusz-cza Bukowa	Gnie-wowo	Dzi-czy Las	Kąty	Wol. Park Nar.	Zam-kowa Góra	Bog-da-niec	Roze-wie	Pusz-cza Bukowa	Zam-kowa Góra	Boże pole
Number of plots	1	1	6	3	2	5	3	1	3	1	3	1	1
Number of observations on the plots	8	6	33	10	6	23	18	7	25	6	21	7	6
Number of species	11	9	15	18	10	18	17	11	8	9	11	12	12
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dasyscyphus virgineus	$1/3^{2}$	$1/3^{2-3}$	$5/5^{2}$	$3/3^{2}$	$2/2^{2}$	$5/16^{1-3}$	$2/4^{2}$	$1/3^{2-3}$	$3/16^{1-2}$	$1/3^{2-3}$	$3/3^{2}$	$1/3^{2-3}$	$1/3^{2}$
Collybia peronata	$1/5^{1-2}$	.	$3/4^{+-1}$	$3/3^{1-2}$	$2/2^{1}$	$1/2^{1}$	$3/5^{1}$	$1/1^{1}$	$2/5^{1-2}$	$1/1^{1}$	$3/7^{1-2}$	$1/3^{2}$	$1/4^{1-2}$
Phaeomarasmius carpophilus	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	.	$1/1^{1}$	.	$1/1^{2}$	$1/2^{2}$
Clitocybe odora	$1/1^{1}$	$1/1^{1}$	.	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{2}$	$1/1^{2}$	$1/1^{1}$	$1/1^{1}$	.
Marasmius recubans	$1/1^{2}$	$1/1^{1}$	$2/2^{2}$	.	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	$1/1^{1}$
Mycena sanguinolenta	$1/3^{1}$	.	$2/2^{+}$	$3/3^{1}$	.	$3/6^{1}$	$3/4^{1}$	$1/2^{1}$	.	.	$1/2^{1}$	$1/2^{1}$	$1/1^{1}$
Mycena galopoda	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	$2/2^{1}$	$1/1^{1}$	.	$1/2^{1}$	$1/1^{1}$	$1/1^{2}$	$1/2^{1}$	.
Mycena filopes	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	.	$2/2^{1}$	.	.	.	.	$1/1^{+}$	$1/1^{\bullet}$
Mycena mucor	.	.	$1/1^{2}$	$3/3^{3}$	$2/2^{3}$	$4/7^{2-3}$	$1/2^{2}$	$1/1^{3}$	.	.	$1/2^{2}$	$1/1^{2}$	$1/2^{3-1}$
Collybia butyracea var. asema	.	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/1^{1}$	.	$1/1^{1}$	$1/1^{1}$	$1/1^{2}$	$1/3^{1}$
Marasmius splachnoides	.	.	$1/1^{1}$	$3/3^{1-2}$	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	$1/1^{1}$	$1/1^{1}$
Tubaria pellucida	.	.	.	$1/1^{1}$	.	$1/2^{1}$	$1/1^{1}$	.	.	.	$2/2^{2}$	$1/1^{1}$	$1/1^{1}$

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mycena stylobates	.	.	$2/4^{1-2}$	$1/1^{1}$	$1/1^{1}$	.	$3/3^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	.
Mycena amicta	.	.	$1/1^{1}$	$1/1^{1}$	$1/1^{+}$	.	.	.	$1/1^{1}$	+	.	.	.
Mycena chlorinella	.	.	.	$1/2^{2}$	.	$1/1^{2}$	.	.	.	.	.	.	.
Psathyra squamifera ss.Lange	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Mycena gypsea	$1/1^{1}$	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Mycena pelianthina	$1/1^{1}$	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Marasmius bulliardii	$1/2^{1-2}$	$1/1^{+}$	.	.	.	.	.	.	.	.	.	.	.
Mycena fagetorum	.	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Collybia cookei	.	.	$1/1^{2}$	.	.	.	.	.	.	.	.	.	.
Mycena flavoalba	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Coprinus plicatilis	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Collybia cirrhata	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.
Xylosphaera corpophila	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.
Cordyceps militaris	.	.	.	$1/1^{+}$	.	.	.	.	.	.	.	.	.
Pseudoclitocybe cyathiformis	.	.	.	$1/1^{1}$	$2/2^{1}$	$1/2^{1}$	.	.	.	.	.	.	.
Tubaria furfuracea	.	$1/1^{1}$	.	.	.	$5/10^{1-2}$	.	.	$1/2^{1}$	.	.	.	.
Helotium calyculus	.	.	.	.	.	$3/7^{2-3}$	.	.	.	.	.	.	.
Psathyrella vernalis	.	.	.	.	.	$2/3^{1}$	.	.	.	.	.	.	.
Coprinus impatiens	.	.	.	.	.	$2/2^{+}$	.	.	.	.	.	.	.
Clavariadelphus junceus	.	.	.	.	.	$1/2^{2-3}$	.	.	.	.	.	.	.
Clitocybe flaccida	.	.	.	.	.	$1/1^{2}$	.	.	.	.	$1/1^{1}$	.	.
Clitocybe fragrans	.	.	.	.	.	$2/2^{1-2}$	$1/1^{1}$	.	.	.	.	.	.
Marasmius lupuletorum	$1/1^{+}$	.	.	.	.	$2/2^{1-2}$	$1/1^{1}$	.	.	.	.	.	.
Collybia hariolorum	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Collybia confluens	.	.	.	..	.	.	.	$1/1^{2}$	.	.	$1/1^{2}$	.	.
Clitocybe hydrogramma	.	.	.	.	.	.	.	$1/1^{2}$	$2/3^{1-2}$	.	.	.	$1/1^{2}$
Mycena citrinomarginata	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.	$1/1^{1}$

Table 2c

Macromycetes recorded in the Melico-Fagetum association

C. Xylophilous fungi

Subassociation	Ceph. rubrae	Typicum									Festucet. silv.		Calam.
Locality	Wol. Park Nar.	Roze-wie	Pusz-cza Bukowa	Gnie-wowo	Dziczy Las	Kąty	Wol. Park Nar.	Zam-kowa Góra	Bogda-niec	Roze-wie	Pusz-cza Bukowa	Zam-kowa Góra	Boże Pole
Number of plots	1	1	6	3	2	5	3	1	3	1	3	1	1
Number of observations on the plots	8	6	33	10	6	23	18	7	25	5	21	7	6
Number of species	28	19	36	34	23	36	24	28	21	16	29	32	22
1	2	3	4	5	6	7	8	9	10	11	12	13	14
a/ on fallen twigs and branches													
Marasmius alliaceus var. alliaceus	$1/6^{1-2}$	$1/1^{1}$	$6/12^{1-2}$	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/3^{1-2}$	.	$1/1^{1}$	$3/7^{1}$	$1/2^{1}$	$1/3^{1-2}$
Mycena crocata	$1/1^{1}$	$1/3^{+}$	$3/3^{1}$	$1/1^{1}$	$1/1^{1}$	.	$2/2^{1}$	$1/1^{1}$	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$
Polyporus varius var. nummularius	$1/6^{1}$	$1/3^{+-1}$	$3/5^{+-2}$	$3/5^{1}$	$1/1^{1}$	$1/1^{+}$	$3/7^{1}$	.	$1/1^{1}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$
Mycena vitilis	$1/2^{1}$	$1/2^{1}$	$2/5^{1}$	$3/6^{1}$	$2/5^{1}$	$2/3^{1}$	$2/2^{1}$	$1/2^{1}$	$2/5^{1}$	$1/2^{1}$	.	$1/1^{1}$	$1/1^{1}$
Marasmius rotula	$1/1^{1}$	$1/2^{2}$	$4/7^{1-2}$	$1/1^{1}$	$1/1^{1}$	$4/5^{1}$	.	.	$1/1^{2}$	$1/1^{1}$	$2/4^{2}$	$1/2^{1-2}$	.
Hydropus subalpinus	.	.	$2/2^{1}$	$1/1^{1}$	$2/4^{1}$	.	.	.	.	.	$1/1^{2}$	.	.
Marasmiellus ramealis	$1/1^{2}$	.	.	.	$1/1^{2}$	$1/1^{1}$	.	.	.	.	$1/1^{2}$	.	.
Exidia glandulosa	.	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/2^{2}$	.	$1/1^{1}$	.	.	.	$1/1^{1}$	.
Psathyrella fusca	.	.	.	.	$1/2^{2}$	.	$1/1^{1}$	.	.	$1/1^{1}$	.	$1/1^{1}$	.
Tyromyces caesius	.	.	.	$2/x^{1}$	.	.	.	$1/x^{1}$	.	.	.	$1/x^{1}$	.
Psathyrella obtusata	.	$1/1^{+}$	.	$1/1^{1}$	.	$2/2^{1}$	.	.	.	.	.	.	.
Cythus striatus	$1/3^{2}$	.	.	$1/1^{1}$	.	.	$1/1^{1}$	.	.	.	.	.	.
Polyporus brumalis	$1/1^{1}$	.	$2/2^{1-2}$	.	.	$3/7^{1}$	.	.	.	.	.	.	.
Marasmius alliaceus var. subtilis ss.Lange	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	$1/1^{1}$
Pluteus cinereo-fuscus	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Crepidotus mollis	.	$1/3^{2-3}$	.	.	.	.	.	.	.	.	.	.	.
Crepidotus luteolus	.	$1/2^{1-3}$	.	.	.	.	.	.	.	.	.	.	.
Crepidotus cinnabarinus	.	$1/1^{2}$	.	.	.	.	.	.	.	.	.	.	.
Pluteus salicinus	.	..	$3/3^{+-1}$	.	.	.	.	.	.	.	.	.	.
Hapalopilus nidulans	.	.	$1/x^{1}$	.	.	.	.	.	.	.	.	.	.
Mycena acicula	.	.	$1/1^{1}$	.	.	.	.	.	.	$1/1^{1}$	.	.	.
Tremella mesenterica	.	.	$2/2^{1}$	$1/1^{1}$	.	.	.	$1/1^{2}$	.	.	.	.	.
Lentinellus omphalodes	.	.	.	$1/1^{2}$	.	$1/1^{2}$	.	.	.	.	.	.	.
Crepidotus variabilis	.	.	.	$1/1^{1}$	.	$2/5^{1-2}$	.	.	.	.	.	.	.
Calocera cornea	.	.	.	.	.	$2/2^{1-2}$	.	.	.	.	.	.	.
Crucibulum laeve	.	.	.	.	.	$1/1^{2}$	.	.	.	.	.	.	.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pluteus semibulbosus	.	.	.	.	.	.	.	$1/1^1$	.	$1/1^1$	.	$1/1^1$	.
Pycnoporus cinnabarinus	.	.	.	.	.	.	.	.	.	.	$1/2^1$	.	.
Mycena tenerrima	.	.	.	.	.	.	.	.	.	.	.	$1/1^1$	.
Inonotus radiatus var. noduloaus	.	.	.	.	.	.	.	.	.	.	.	$1/x^1$	.
b/ on stumps and logs													
Pluteus cervinus ss. Lange	$1/3^1$	.	$2/2^{1-2}$	$3/3^1$	$1/1^1$	$2/2^1$	$2/2^1$	$1/1^2$	$2/3^{+-1}$	$1/1^1$	$1/1^1$	$1/2^2$	$1/1^1$
Kuehneromyces mutabilis	$1/1^2$	.	$2/5^{1-2}$	$3/6^1$	$2/2^1$	$1/1^2$	$1/1^1$	$1/1^1$	$2/7^{1-2}$	.	$1/5^2$	$1/3^2$	$1/1^2$
Armillariella mellea	$1/1^1$	.	.	$2/2^1$	$1/1^2$	$3/5^{1-2}$	$1/1^1$	$1/2^{1-2}$	$2/9^{1-2}$	.	$1/1^2$	$1/2^{1-2}$	$1/3^2$
Xylosphaera hypoxylon	.	$1/x^2$	$1/x^3$	$3/x^1$	$1/x^1$	$4/x^{1-2}$	$2/x^2$	$2/x^2$	$1/x^2$	.	$3/x^2$	$1/x^2$	$1/x^1$
Ustulina deusta	$1/x^1$	$1/x^1$	$1/x^2$	$3/x^2$	.	$1/x^1$	$1/x^1$	.	$1/x^1$	$1/x^2$	$2/x^1$	$1/x^2$	$1/x^2$
Hypholoma sublateritium	.	.	$3/6^{1-2}$	$1/1^1$	.	$2/5^{1-2}$	$2/2^2$	$1/2^{1-2}$	$2/8^{1-2}$	.	$3/5^2$	$1/2^2$	$1/3^2$
Trametes varicolor	.	$1/x^2$	$4/x^2$	$2/x^2$	.	$2/x^{1-2}$	$2/x^2$	.	$1/x^2$	$1/x^2$	$1/x^1$	$1/x^1$	$1/x^2$
Hypholoma fasciculare	.	.	$1/1^2$	$2/2^2$	$1/1^2$	$3/6^2$	$1/1^2$	$1/2^2$	$1/2^1$	.	$1/1^1$	$1/1^2$	$1/3^2$
Lycoperdon pyriforme	.	.	$3/4^{1-3}$	$1/1^2$	$1/1^2$	$1/1^1$	$1/1^1$	$1/1^2$	$3/21^{1-2}$	$1/1^1$	.	$1/1^1$	$1/2^2$
Mycena galericulata	$1/1^1$	$1/1^1$	$3/3^2$	.	.	$1/2^{1-2}$	$1/1^1$	.	$2/8^{1-2}$	.	$2/3^{1-2}$	$1/2^1$	$1/1^1$
Mycena alcalina	$1/1^1$	$1/1^1$	.	$1/1^1$	$1/1^1$	.	.	$1/2^1$	.	$1/1^1$	.	.	$1/1^1$
Oudemansiella platyphylla	$1/2^1$	.	$4/8^1$	.	$2/2^1$	$1/1^1$	.	$1/1^1$	.	.	$1/4^1$	.	.
Sterum hirsutum	.	.	$2/x^2$	$2/x^2$	.	.	.	$1/x^2$	.	.	.	$1/x^1$	$1/x^1$
Mycena inclinata	.	.	$1/1^2$	.	.	.	$1/1^2$	.	$1/3^{1-2}$	.	$1/1^3$	.	$1/1^3$
Coprinus leoninus	$1/1^1$	.	$1/3^1$	.	.	$1/1^1$	$1/1^1$	.	.	.	.	$1/1^+$	.
Gerronema fibula	.	.	$1/1^1$	.	.	$1/2^1$	.	.	$1/1^1$	.	$1/1^1$	$1/2^1$	.
Trametes gibbosa	.	.	.	$2/x^1$	.	$2/x^1$	.	.	.	.	$1/x^2$	$1/x^1$	.
Schizophyllum commune	$1/1^2$	.	.	.	.	.	.	.	.	.	.	.	.
Bolbitius vitellinus var. titubans	$1/1^1$	.	.	.	.	.	.	.	.	.	.	.	.
Rhodophyllus rhodocylix	$1/1^1$	.	.	.	.	.	.	.	.	.	.	.	.
Psathyrella spadiceo-grisea	$1/1^+$	$1/2^1$	.	.	.	.	.	.	.	.	.	.	.
Flammulina velutipes	.	$1/2^1$	.	.	.	.	.	.	$1/2^2$	.	.	.	.
Pluteus chrysophaeus	.	$1/1^1$	.	.	.	.	.	.	.	.	.	.	.
Bulgaria inquinans	.	.	$1/1^3$	.	.	.	.	.	.	.	.	.	.
Mycena haematopoda	.	.	$1/1^2$	.	.	.	..	..	.	.	.	.	.
Pluteus nanus	.	.	$1/1^1$	.	.	.	.	.	.	.	.	.	.
Xylosphaera polymorpha	.	.	$1/x^2$	.	.	.	$1/x^1$	.	.	.	.	.	.
Hymenochaete rubiginosa	.	.	$1/x^2$	.	$2/x^1$	.	.	.	$1/x^2$	.	.	.	.
Trametes hirsuta	.	.	$1/x^2$	$1/x^1$	.	.	.	.	.	.	.	.	.
Bjerkandera adusta	.	.	.	$3/x^1$	.	.	.	$1/x^2$	.	.	.	.	.
Ganoderma lucidum	.	.	.	$1/x^2$	.	.	.	$1/x^1$	.	.	.	.	.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Coryne sarcoides	.	.	.	$1/1^{1}$	.	$1/1^{1}$	.	$1/1^{1}$	.	.	.	.	.
Polyporus ciliatus	.	.	.	$1/1^{1}$	$1/1^{1}$	$2/4^{+}$	.	.	.	.	.	.	.
Mycena tintinnabulum	.	.	.	.	.	$5/9^{2-6}$	.	.	.	.	.	.	.
Collybia succinea	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.
Pluteus pseudoroberti	.	.	.	.	.	.	$2/2^{1}$	.	.	.	.	.	.
Gymnopilus penetans	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.
Chlorosplenium aeruginosum	.	.	.	.	.	.	.	$1/1^{2}$	.	.	.	.	.
Lentinellus cochleatus	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Pluteus phlebophorus	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.	.	.
Merulius tremellosus	.	.	.	.	.	$1/1^{1}$	.	$1/1^{1}$	$1/3^{1}$	.	[illegible]	.	.
Mycena polygramma	.	.	.	.	.	.	.	$1/1^{1}$	$2/1^{1}$	.	$1/1^{1}$	.	.
Ganoderma applanatum	.	.	.	.	.	.	.	$1/x^{2}$	.	.	$1/x^{1}$	$1/x^{1}$	$1/x^{1}$
Scutellinia scutellata	.	.	.	.	.	.	.	.	.	.	$1/1^{2}$	$1/1^{2}$	.
Psathyrella hydrophila	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	$1/2^{2}$	$1/1^{1}$
Panellus stypticus	.	.	.	.	.	.	.	.	.	.	.	$1/2^{2}$	$1/3^{3}$
c/ on trunks and roots													
Oudemansiella radicata var. radicata	$1/6^{1}$	$1/2^{+-1}$	$4/9^{1}$	$2/3^{1}$	$2/2^{1}$	$1/1^{1}$	$3/10^{1}$	$1/1^{2}$	$3/6^{1-2}$	$1/1^{1}$	$3/12^{1-2}$	.	$1/2^{1}$
Oudemansiella mucida	$1/1^{2}$	.	.	.	.	$1/1^{1}$	$1/2^{1}$	.	$1/2^{1-2}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.
Fomes fomentarius	.	.	$3/x^{1}$	.	.	$1/x^{1}$	.	$1/x^{1}$	.	.	$3/x^{1}$	$1/x^{1}$	$1/x^{1}$
Oudemansiella radicata var. gracilis ss.Lange	$1/1^{1}$	$1/1^{1}$	$2/2^{1}$	.	.	.	.	.	.	.	$2/2^{1}$	.	.
Polyporus melanopus	$1/1^{1}$	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.
Galerina hypnorum	$1/3^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Galerina embolus	$1/2^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Gerronema fibula	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Polyporus squammosus	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.	.	.
Pholiota aurivella	.	.	$2/2^{2}$	.	.	.	.	.	.	.	.	.	.
Phellinus igniarius	.	.	$1/x^{2}$	.	.	.	.	.	.	.	$1/x^{1}$	.	.
Lactiporus sulphureus	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.	.
Lyophyllum ulmarium	.	.	.	$1/1^{2}$	.	.	.	.	.	.	.	.	.
Hebeloma radicosum	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.	.
Oudemansiella badia	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.
Auricularia auricula	.	.	.	.	$1/1^{1}$	.	.	.	.	.	.	.	.
Pleurotus ostreatus	.	.	.	.	.	$1/1^{2}$	.	.	.	.	.	.	.
Pholiota squarrosa	.	.	.	.	.	$1/1^{2}$	.	.	.	.	.	.	.
Collybia fusipes	.	.	.	.	.	.	$1/1^{1}$	.	.	.	$1/1^{2}$	.	.
Mycena parabolica	.	.	.	.	.	.	.	.	.	$1/1^{1}$	.	.	.

b) *Melico-Fagetum typicum*

The typical *Melico-Fagetum* subassociation belongs to beech forest communities most abundantly represented in north-western Poland. Therefore, the highest number of permanents plots (25) was selected here in Western Pomerania and in Poznań Province (Fig. 1).

Melico-Fagetum typicum is connected mainly with mesophilic habitats of the terminal and ground moraine zone, though occasionally it occurs in poorer habitats. Brown, sometimes leached soils, of slightly acid reaction (pH 5-6) in the superficial layer, prevail in patches of this subassociation. The typical subassociation is floristically the richest. Beeches dominate in the tree stand, whereas oak, ash, sycamore and hornbeam may constitute only an admixture. In normally compact tree stands, generally no shrub layer occurs. The following plants exhibit the highest constancy in the field layer: *Melica uniflora, Asperula odorata, Galeobdolon luteum, Anemone nemorosa, Viola silvestris, Festuca silvatica, Milium effusum* and others.

The mycosociological tables give no further division of this subassociation into lower units, since phytosociologists divide it into variants and facies differing from each other mainly by dominance of certain species in the field layer.

The plot established in the beech forest at the foot of the high (about 55 m) cliff in Rozewie is most characteristic. The foot of the cliff is occupied by a humid beech forest community (Kobendza 1935), to which ash and sycamore contributes considerably. *Equisetum hiemale* forms compact patches in the field layer. Beside species characteristic of beech forests, in this layer occur also certain orchids and a number of species common in oak-hornbeam forests.

Many of the fungal species observed on other patches of the subassociation studied were not found on this plot. This concerns mainly synusiae of terrestrial fungi and those fructifying on minute plant remnants (Tables 2a, b). Only *Peziza succosa* and *Leptopodia pezizoides* were distinguishing species here. Of the xylophilous group, fruit bodies were observed of most beech forest species as well as of several species of the genus *Crepidotus*, such as *C. mollis, C. luteolus* and *C. cinnabarinus*, which occurred abundantly on fallen ash branches (Table 2c).

The plot established on an almost flat area at the top of the cliff in Rozewie is not so distinct as regards the vascular and fungal flora. The tree stand consists exclusively of beeches, whereas the herb layer exhibits a certain contribution of species characteristic of oak-hornbeam forests. The mycoflora was both quantitatively and qualitatively poorer than on other patches of the typical subassociation of the lowland beech forest, but it included most of the fungal species characteristic of beech forests. In the table of xylophilous fungi the very low number of fungi growing on stumps is noteworthy. This is due to the almost complete lack of rotting wood on the studied plot of this community.

The patches of the typical subassociation in the Beech Forest near Szczecin were richest in fungi. This community predominates here, occupying habitats optimal for the development of the beech trees that show the greatest vitality in comparison with other trees, for example with oak (Celiński 1962). The shrub layer is very loose. *Melica uniflora*, *Festuca silvatica*, *Dentaria bulbifera* and species of the *Fagetalia* order play the main role in the field layer.

Mycological observations in the Beech Forest were carried out on six permanent plots, on which the highest number of both terrestrial (53) and xylophilous (38) fungal species were found. Among them, species characteristic of beech forests, common to most patches of this subassociation in north-western Poland, prevailed. Besides, an ample group of ubiquitous species occurred here. Also a certain contribution of species mostly found in oak-hornbeam forests was observed (Lisiewska 1965). Here belong: *Amanita phalloides*, *Inocybe asterospora*, *Tricholoma lascivum*, *Lactarius pyrogalus* and *Russula virescens* (Table 2a). Their presence is atributable to the influence of single oaks occurring on some plots. *Bulgaria inquinans*, *Hymenochaete rubiginosa* and *Laetiporus sulphureus* fructified on sporadically occurring oak logs and also on the oak stumps.

The plots established in the forest district Dziczy Las near Pyrzyce on the border of the Myślibórz Lakeland differ slightly, as regards the habitat and floristic composition, from the patches studied in the Beech Forest near Szczecin. Only the area is somewhat flatter and the landscape less diversified. The beech forests occurring here are well developed, homogeneous and floristically rich (Balcerkiewicz 1971).

Sporadic observations carried out in this region demonstrated fructification of only a small number of fungal species, but even these, sufficiently characterize the beech forest community, e.g. *Hydropus subalpinus*, *Marasmius alliaceus*, *Mycena crocata*, *Marasmius splachnoides*, and *Mycena mucor*.

Well developed patches of the typical subassociation occur also in the forest district Gniewowo in the Kashubian Lakeland. This considerably undulating moraine country is covered with a fertile beech forest, in the tree stand of which almost exclusively beeches and sporadically planted Douglas firs occur. There is no shrub layer, whereas the field layer consists of species characteristic of the *Melico-Fagetum* association and of these belonging to the *Fagetalia* order.

In respect to mycoflora, the three plots established in this community, did not differ in principle from the discussed patches of the typical subassociation of *Melico-Fagetum*.

Further plots for mycosociological studies were selected in the northern part of the Poznań Province in the forest district Kąty, where the beech occurs on an isolated area beyond its natural eastern range. The beech trees overgrow low, rather undulating moraine hills. Degraded brown earths prevail and on some sites podsolisation is observed. The tree layer consists almost exclusively of beech with a compact canopy, thus the forest floor is intensively shaded. Hornbeams and sycamores occur occasionally. *Melica uniflora* and *Asperula odorata* are widespread and on one plot *Corydalis cava* dominates.

Two-year mycological studies were performed in Kąty by Endler (1971). This beech forest has the richest mycoflora. On the five plots established in various facies, fruit bodies of 50 terrestrial fungal species, 18 — on minute plant remnants and 36 xylophilous species were recorded. A rather numerous group of fungi noticed on all the patches of the typical *Melico-Fagetum* association in Western Pomerania was observed here, but some of the species characteristic of the Pomeranian beech forest, such as *Mycena crocata* and *Hydropus subalpinus* were absent, whereas single fruit bodies of *Marasmius alliaceus* and *Oudemansiella radicata* were found only once. However, *Coprinus picaceus*, rather freguently recorded and abundantly occurring in the facies with *Asperula odorata* as well as *Stropharia squamosa* and the less frequent species, such as: *Lactarius blennius*, *Craterellus cornucopioides*, *Otidea cochleata* and *Clavariadelphus junceus* are the locally distinguishing species here. In autumn *Mycena tintinnabulum* fructified in masses on beech stumps all over the area.

Patches of the *Melico-Fagetum* typical subassociation in the south-western part of the Wolin Island represent a somewhat different type of beech forest, as regards the habitat and floristic composition. These patches cover gentle slopes of the diluvial part of the island. The beech forest, though old and perfectly developed, has been changed considerably by human management. Beech, with a slight admixture of *Quercus petraea*, prevails in the tree stand. The compactness of the shrub layer consisting exclusively of young beeches and is very low. On all the patches the field layer is particularly poor. In additio to representatives of the *Fagetalia* order of a wide ecological extent, acidophilous species, characteristic of mixed forests (Piotrowska 1966) also play an important role in this layer.

The habitat conditions are reflected to some extent in the mycoflora composition on the Wolin Island (Lisiewska 1966a). A relatively numerous group of macromycetes recorded in beech and other deciduous forests of the order *Fagetalia*, as well as some fungal species found in acidophilous mixed forests on sandy soils, such as *Gyroporus cyanescens*, *Tricholoma ustale* and *Cystoderma amiantinum* (Table 2a) were observed here.

The patch of beach forest in the reservation Zamkowa Góra in the Kashubian Lakeland belongs to the poorer communities of the typical lowland beech forest. It is situated within the range of the ground moraine of the Pomeranian stage of the Baltic glaciation. Brown earth impoverished to various degrees is the main type of the soil here. Several forest communities have been described in this reservation and among them the *Melico-Fagetum* association (Matuszkiewicz 1966). Mycosociological research were performed on a single plot situated on the lower part of a northward slope of the hill. The tree stand consists only of beeches, the shrub layer is absent and the field layer exhibits species typical of this association.

As regards the mycoflora, this patch did not differ from other beech forest communities. *Stropharia squamosa* and *Lactarius vellereus* were the only terrestrial fungi fruiting relatively abundantly, whereas on fallen beech branches — *Marasmius alliaceus* was noted. The rare fungal species — *Strobilomyces floccopus* was also found here.

The forest district Bogdaniec in the western part of the Gorzów Valley, on the northern border of the Toruń—Eberswald ice marginal stream valley is the last area of studies on macromycetes of the *Melico-Fagetum* typical subassociation. Observations were carried out on three plots established in a poor grassy facies of the beech forest overgrowing slopes of eminences with leached brown earth and a shallow humus horizon (about 15 cm) and acid soil reaction (pH 5.5.) in the zone of development of the mycelium. The very dense tree stand consists of beech and hornbeam. The same tree species form the weakly developed shrub layer. In the field layer mostly *Melica uniflora* becomes dominant forming compact patches (Celiński and Filipek 1956).

Terrestrial fungi were dominant on the plots studied. Among them, representatives of the genera *Russula* and *Lactarius* were most abundant. Species recorded in various beech communities were repeatedly observed here. Moreover, fruit bodies of several macromycetes most frequently found in oak-hornbeam forests, occurring on more fertile and humid habitats in the neighbourhood of the beech forest studied, were recorded in the latter. Here belong: *Amanita phalloides*, *Lepista nuda*, *Russula virescens*, *Clitocybe nebularis*, *Tricholoma lascivum* and others. On the thick layer of well decomposed leaves numerous fruit bodies were found of fungi connected with this substrate such as *Collybia peronata*, *Clitocybe hydrogramma* and *C. odora*. It is noteworthy, that *Marasmius alliaceus* and *Mycena crocata*, characteristic of beech forests, were on occasion not found here. The contribution of fungi fructifying on fallen branches was very slight owing to the deficit of this substrate. Most xylophilous fungi (Table 2c) were growing on stumps and rotten wood.

c) *Melico-Fagetum festucetosum silvaticae*

Patches of the lowland beech forest subassociation with *Festuca silvatica* were distinguished by Celiński (1962) in the Beech Forest near Szczecin. They overgrow wide areas in the terminal moraine zone, mostly occurring on dry, clayey or loamy slopes and eminences with a higher substrate acidity (pH 4.5-5.5) and shallow humus horizon. On many sites the soil exhibits a character intermediate between brown and podsol type.

As regards the floristic composition, *Melico-Fagetum festucetosum silvaticae* differs from the typical subassociation by the lack of many species of eutrophic character. *Festuca silvatica* predominates here, and in addition the group of acidophilous species is considerable. Beech, with an admixture of solitary oaks, prevails in the tree stand.

Mycosociological investigations performed on three plots in various patches of this community demonstrated the lack of many terrestrial fungi characteristic of humid and fertile habitats with neutral or alkaline soil reaction. On the other hand, most fungal species found in the subassociation with *Festuca silvatica* occurred also in the examined patches of the typical subassociation, particularly on sites where *Melica uniflora* predominated (Table 2a). In the groups of fungi fructifying on leaves and wood the difference between these subassociations was slight (Tables 2b, c). No fungi distinguishing this community were found. Macromycetes characteristic of beech forests, such as: *Marasmius alliaceus*, *Mycena crocata* and *Hydropus subalpinus* occurred here. *Pycnoporus cinnabarinus*, developing fruit bodies on fallen beech twigs, was found only in the subassociation discussed of all the forests studied. The plots in the association *M.-F. festucetosum silvaticae* in the Beech Forest were those richest in fungi and poorest in vascular plants.

The patch of this subassociation studied in the reservation Zamkowa Góra near Kartuzy was similarly rich in fungi. Matuszkiewicz (1966) classified this community to *Melico-Fagetum* variant with *Deschampsia flexuosa*. In view of the predominance of *Festuca silvatica* and both the floristic and habitat character (considerable similarity to the Beech Forest), however, this patch was included to the *Melico-Fagetum festucetosum silvaticae* subassociation (Piotrowska) *. It covers a 20°,

* According to the recent phytosociological division of W. and A. Matuszkiewicz (1970) the poorest lowland beech forest communities, in the field layer of which *Festuca silvatica* predominates, and where *Deschampsia flexuosa*, *Carex*

northward facing slope. The tree layer consists of beeches with no undergrowth: in the field layer *Festuca silvatica* predominates and is accompanied by *Asperula odorata, Galeobdolon luteum, Majanthemum bifolium, Deschampsia flexuosa, Oxalis acetosella, Luzula pilosa*, and other plants.

As regards the fungi present, the plot established in this community with *Festuca silvatica* was closely similar to that community in the Beech Forest. It also had no distinguishing species, whereas the contribution of fungi of a wider ecological range, frequently passing in to communities of acidophilous oak-beech forests, was higher here.

d) *Melico-Fagetum calamagrostietosum arundinaceae*

The grassy subassociation of the lowland beech forest with predominant *Calamagrostis arundinacea* was described from the Elbląg upland and the western part of Olsztyn Province (T o k a r z 1961, 1971).

Mycological observations in this subassociation were performed in the forest district Bożepole in Gdańsk Province. Small patches of this subassociation cover a slightly undulating moraine area. Podsolised sandy soils of the brown earth type, with an acid reaction (pH 4.0-5.0) predominate here. J e l i n o w s k i (1969) investigated this community from the phytosociological standpoint. The tree layer consists entirely of beeches, with up to 95 per cent compactness of the canopy. The same tree forms the loose shrub layer as well. *Calamagrostis arundinacea, Oxalis acetosella* and *Majanthemum bifolium* dominate in the field layer overgrowing about 40 per cent of the area. *Luzula pilosa, Carex pilulifera* and *Deschampsia flexuosa* are less frequent here. A mose layer occurs on some site.

The dry habitat of the *Melico-Fagetum calamagrostietosum arundinaceae* did not provide favorable conditions for fructification of terrestrial macromycetes. Usually fungal species were recorded only once and in low numbers. Fungi common in beech forests, such as *Boletus erythropus, Russula mairei, Lacterius blennius* and several species of a wider ecological range were fruiting somewhat more abundantly. Many of the species occurring in patches of the typical subassociation and some observed in the *Melico-Fagetum festucetosum silvaticae* were absent here. Three species of terrestrial fungi were recorded exclusively from the subassociation with *Calamagrostis arundinacea*, in view, however, of their single appearance they cannot be assumed to be diagnostic for this community.

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pilulifera, Dicranella heteromalla and *Dicranum scoparium* are distinguishing species, are classified to the subassociation *Melico-Fagetum deschampsietosum*.

The group of macromycetes developing fruit bodies on fallen leaves was more frequently represented owing to the presence of slightly decomposed leaf litter. *Dasyscyphus virgineus* in spring and *Phaeomarasmius carpophilus* in the course of summer fructified abundantly on the beechmasts. *Collybia peronata* was observed several times on leaves, whereas *Mycena mucor* and *Clitocybe hydrogramma* occurred in masses on the same substratum in autumn. Only 5 species (among them species characteristic of beech forests) were found on fallen beech branches. Most xylophilous fungi grew on rotten beech stumps (Table 2c).

3. Communities of acidophilous oak-beech forests

In order to obtain a complete picture of the macromycete flora of various forest communities of north-western Poland in which beech plays an important role, acidophilous oak-beech forests, rather common in Western Pomerania, were also taken into consideration.

The systematic position of these communities is not yet completely decided. This particularly concerns patches poor in vascular plants, in which mosses play the most important role. These forests are classified mainly to the *Fago-Quercetum* association, which belongs to the class *Quercetea robori-petracae* Br.-Bl. et R.Tx. 1943 comprising diciduous forests of eastern Europe (Celiński 1962; Piotrowska 1966 and others). According to the opinion of W. and A. Matuszkiewicz (1970) the patches of poor, acidophilous beech forest communities should be classified to the *Trientali-Fagetum* association Tx. 1960 belonging to the *Luzulo-Fagion* suballiance within the clase *Querco-Fagetea* Br.-Bl. et Vlieg. 1937.

In view of the differing views of phytosociologists on the systematics of the communities discussed, they are in the present work referred to as acidophilous oak-beech forests and within them the grass form with predominating vascular flora (mainly grasses) and the moss form were distinguished.

A well developed mixed forest community, with a relatively rich herb layer, occurs in the Wolin Island National Park. This community, described as *Fago-Quercetum* (Piotrowska 1966; Piotrowska, Żukowski 1967), is associated exclusively with the diluvial part of Wolin Island and mostly occurs on gentle slopes and plateaux of the terminal moraine. It covers acid (pH 5.0-5.5) brown soils with 2-3 cm thick layer of undecomposed raw humus above the humus horizon. Beeches prevail in the tree layer, but these is a slight admixture of sessile oaks and pines. Naturally seeded beeches and, on some sites, sessile oaks form the rather loose shrub layer. The field layer consists of about 45 vascular plant species, among which *Calamagrostis arundinacea*, and on some sites *Majanthemum bifolium* and *Oxalis acetosella* predominate. The following species are diagnostic here: *Lonicera periclymenum*, *Lathyrus montanus* and *Viola riviniana*. Moreover, species of the order *Fagetalia* sporadically occur. Mostly the moss layer is weakly developed.

Mycosociological research performed on 10 permanent plots in various parts of the Wolin Island National Park (Lisiewska 1966a) demonstrated a great number of macromycetes in this community — 66 species of terrestrial fungi (Table 3a).

Only 7 fungal species were collected on fallen leaves and minute plant remnants.

Of the xylophylous fungi, *Marasmius alliaceus* exhibited a very low contribution (found twice), whereas *Mycena crocata* and other beech forest fungi were not found at all. The group of fungi growing on rotten stumps was more numerous and species connected with beech wood prevailed here (Table 3b).

Beside the patches of acidophilous, oak-beech forest, exhibiting a field layer with dominating vascular plants, a mossy form of this community was distinguished in the Wolin Island National Park as the subassociation *Fago-Quercetum dicranetosum*. According to W. and A. Matuszkiewicz (1970) as well as to the most recent opinion of Piotrowska, the patches of this forest should be classified to the *Trientali-Fagetum* association.

This community, as compared with the former one, occupies a relatively small area; it covers steep, northern and north-western slopes of a terminal moraine. Gusty, westerly winds, frequent on Wolin Island remove the litter from the slopes. The soil is compact, sandy, distinctly podsolised (pH 4.0-4.5). The tree layer consists almost entirely of the dominant beech, but occasionally oaks and pines occur. The shrub layer also consisting of beeches is very scarce. The floristic composition of the field layer is very poor and only *Deschampsia flexuosa*, *Vaccinium myrtillus* and *Luzula pilosa* covering 10 per cent of the area surface need be mentioned. In contrast the moss layer is perfectly developed and covers 90 per cent of the area.

The contribution of macromycetes to the patches of the mossy beech forest was far lower than that to the former community. Fungi forming the synusia in the rich moss layer, such as *Gerronema fibula*, *Galerina hypnorum*, *G. mniophila*, etc. are noteworthy here. Species distinguishing the mossy form from other beech forest communities were observed. Here belongs *Cordyceps ophioglossoides*, numerous stromae of which grew on rather abundantly fructifying *Elaphomyces granulatus*. Other terrestrial fungi mostly belong to components of deciduous forests of

Table 3a

Macromycetes recorded in acidophilous oak-beech forests

A. Terrestrial fungi

Form	with grasses	with mosses					
Locality	Wol. Park Nar.	Wol. Park Nar.	Puszcza Bukowa	Puszcza Darżl.	Gardna	Zamkowa Góra	Kąty
Number of plots	10	2	1	1	11	1	1
Number of observations on the plots	50	10	5	5	3	7	20
Number of species	66	38	38	26	31	29	22
1	2	3	4	5	6	7	8
Russula mairei	$6/10^{1}$	$2/7^{1}$	$1/4^{1}$	$1/1^{1}$	$1/2^{2}$	$1/2^{1-2}$	$1/1^{1}$
Amanita citrina	$6/12^{1}$	$2/5^{1}$	$1/2^{1}$	$1/1^{1}$	$1/2^{1}$	$1/1^{1}$	$1/3^{1}$
Cantharellus cibarius	$2/6^{1}$	$1/2^{1}$	$1/2^{2}$	$1/2^{1-2}$	$1/2^{1}$	$1/3^{2}$	$1/9^{1-2}$
Galerina hypnorum	$1/3^{1}$	$2/5^{1}$	$1/2^{1}$	$1/2^{2}$	$1/2^{1}$	$1/2^{1}$	$1/1^{1}$
Dermocybe cinnamomeolutea	$2/2^{1}$	$2/4^{1-2}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	$1/2^{1}$	.
Mycena galopoda	$4/10^{1}$	$2/6^{1}$	$1/2^{1}$	$1/2^{2}$	$1/1^{1}$	.	.
Boletus edulis	$5/5^{1}$	$1/2^{1}$	$1/2^{1}$	$1/2^{1-2}$	$1/1^{1}$	$1/1^{2}$	.
Laccaria amethystina	$2/8^{1}$	$2/4^{1}$	$1/3^{1-2}$	.	$1/1^{1}$	$1/1^{1}$	.
Cystoderma amiantinum	$2/2^{1}$	$1/1^{1}$	$1/1^{1}$	.	$1/1^{1}$	$1/1^{1}$	.
Russula cyanoxantha	$6/14^{1}$	$2/6^{1-2}$	$1/5^{1}$	$1/1^{1}$	$1/1^{2}$	.	.
Russula fellea	$3/3^{1-2}$	$1/1^{1}$	$1/1^{1}$	.	$1/1^{2}$	$1/2^{1}$	.
Lactarius blennius	$5/10^{1-2}$	.	$1/1^{1}$	.	$1/2^{1}$	$1/1^{1}$	$1/1^{+}$
Xerocomus chrysenteron	$6/14^{1-2}$	$2/6^{1}$	$1/2^{1}$	.	$1/1^{1}$	.	.
Collybia dryophila	$8/10^{1}$	$1/2^{1}$	.	$1/2^{2}$	.	.	.
Lactarius camphoratus	$4/10^{1}$	$2/4^{1}$	.	$1/1^{1}$	.	$1/1^{1}$	$1/3^{1}$
Xerocomus subtomentosus	$4/8^{1}$	$1/1^{1}$	.	.	$1/1^{1}$	.	$1/1^{1}$
Tricholoma sulphureum	$4/8^{1}$	.	$1/1^{1}$	.	.	.	$1/1^{1}$
Lactarius piperatus	$2/2^{1-2}$	.	$1/2^{1}$	$1/1^{1}$	.	.	.
Hydnum repandum	$2/2^{1}$	.	.	$1/1^{1}$	$1/1^{1}$	$1/2^{2}$	$1/1^{1}$
Mycena epipterygia	$1/2^{1}$	$1/1^{1}$	.	.	$1/1^{1}$	$1/1^{1}$	.
Russula alutacea	$1/1^{1}$	.	$1/1^{1}$	$1/1^{1}$	$1/1^{2}$	.	$1/1^{1}$
Inocybe lanuginosa	$1/1^{1}$	.	.	$1/2^{2}$	$1/1^{1}$	.	$1/1^{1}$
Leotia lubrica	$1/1^{1}$	.	$1/1^{2}$	.	.	$1/1^{2}$	.
Laccaria proxima	$1/1^{1}$	.	.	.	$1/1^{1}$	$1/1^{1}$	.
Russula densifolia	$1/1^{1}$	.	$1/1^{1}$	.	.	$1/1^{1}$	.
Boletus erythropus	$1/2^{1}$	.	.	.	$1/2^{2}$	.	..
Cortinarius collinitus	$1/1^{1}$	.	.	$1/1^{1}$	.	$1/2^{1}$	.
Russula delica	$1/1^{1}$	.	.	.	.	.	$1/1^{1}$
Laccaria laccata	$1/1^{1}$	.	$1/1^{1}$	.	$1/1^{1}$	.	.
Cortinarius anomalus	$1/1^{1}$	.	.	.	.	.	$1/1^{1}$
Amanita rubescens	$4/10^{1}$	$1/2^{1}$	$1/2^{1}$	.	$1/1^{1}$	.	.
Dermocybe semisanguinea	$1/1^{1}$	$2/3^{1}$	$1/1^{1}$	.	.	.	.
Inocybe gausapata	$1/1^{1}$	$1/1^{1}$	$1/2^{1}$	.	.	.	.
Amanita gemmata	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	.	.	.	.
Lycoperdon perlatum	$5/10^{1}$	$1/3^{1}$	.	.	.	.	.
Mycena pura	$4/10^{1}$	$2/6^{1}$	.	.	.	.	.
Clitocybe infundibuliformis	$3/3^{1}$	$1/1^{1}$	.	.	.	.	.
Russula albonigra	$2/2^{1}$	$1/1^{1}$	.	.	.	.	.
Tylopilus felleus	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.
Suillus variegatus	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.
Rhodophyllus cetratus	$1/1^{1}$	$1/1^{1}$	.	.	.	.	.
Amanita fulva	$4/8^{1}$	.	.	.	.	.	.
Lactarius vellereus	$4/5^{1}$	.	.	.	.	.	.
Hygrophorus eburneus	$3/4^{1-2}$	.	.	.	.	.	.
Helvella crispa	$2/3^{1}$	.	.	.	.	.	.

1	2	3	4	5	6	7	8
Otidea leporina	$2/2^{1-2}$	.	.	.	.	.	.
Clitocybe nebularis	$2/2^{1-2}$	.	.	.	.	.	.
Cortinarius bolaris	$2/2^{1}$	.	.	.	.	.	.
Scleroderma aurantium	$2/2^{1}$	.	.	.	.	.	.
Lepiota seminuda f. minima ss.Lange	$2/2^{1}$	.	.	.	.	.	.
Stropharia squamosa	$2/2^{1}$	.	.	.	.	.	.
Russula chamaeleontina	$2/2^{1}$	.	.	.	.	.	.
Inocybe hirtella	$2/2^{1}$	.	.	.	.	.	.
Lactarius subdulcis	$2/2^{1}$	.	.	.	.	.	.
Inocybe geophylla var. violacea	$2/2^{1}$	.	.	.	.	.	.
Lepiota clypeolaria	$1/1^{1}$	.	.	.	.	.	.
Inocybe descissa var. brunneo-atra	$1/1^{1}$	.	.	.	.	.	.
Macrolepiota procera	$1/1^{1}$	.	.	.	.	.	.
Agaricus silvicola	$1/1^{1}$	.	.	.	.	.	.
Amanita vaginata	$1/1^{1}$	.	.	.	.	.	.
Inocybe geophylla var. geophylla	$1/1^{1}$	.	.	.	.	.	.
Lactarius pyrogalus	$1/1^{1}$	.	.	.	.	.	.
Chroogomphus rutilus	$1/1^{1}$	.	.	.	.	.	.
Cortinarius bovinus	$1/1^{1}$	.	.	.	.	.	.
Inocybe umbrina	$1/1^{1}$	.	.	.	.	.	.
Cantharellus tubaeformis	.	$1/2^{2}$	$1/3^{2}$	$1/2^{1}$	$1/2^{2}$	$1/2^{2}$	$1/1^{1}$
Russula vesca	.	$1/3^{1}$	$1/1^{1}$	$1/2^{2}$	$1/1^{1}$	$1/1^{1}$	$1/3^{1}$
Russula nigricans	.	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$	$1/1^{1}$
Cordyceps ophioglossoides	.	$2/2^{1-2}$	$1/3^{1-2}$	$1/2^{1}$	.	$1/1^{1}$	.
Elaphomyces granulatus	.	$2/2^{1-2}$	$1/3^{2}$	$1/2^{1}$	.	$1/1^{2}$	.
Gerronema fibula	.	.	$1/2^{1}$	$1/2^{2}$	$1/1^{1}$	$1/1^{1}$	$1/2^{1}$
Galerina mniophila	.	$2/4^{1}$	$1/2^{2}$	$1/2^{1}$	.	.	.
Dermocybe cinnamomea	.	.	$1/4^{1-2}$	.	$1/1^{1}$	$1/1^{1}$	.
Cantharellus cinereus	.	$1/2^{2}$	$1/2^{2}$	$1/1^{1}$	.	.	$1/2^{1}$
Cortinarius flexipes	.	$1/1^{1}$	$1/1^{1}$	.	$1/1^{1}$	.	.
Phallus impudicus	.	$1/1^{1}$	.	.	$1/2^{1}$	.	.
Tricholoma ustale	.	$1/1^{1}$	.	.	.	.	.
Inocybe napipes	.	$1/1^{1}$	.	.	.	.	.
Cortinarius glandicolor	.	..	$1/3^{1}$	.	.	.	.
Clavulina cristata	.	.	$1/2^{1}$	.	.	.	.
Russula violacea	.	.	$1/1^{1}$	.	.	.	.
Clavulina cinerea	.	.	$1/1^{1}$	.	.	.	.
Lactarius pallidus	.	.	$1/1^{1}$	.	.	.	.
Omphalina ericetorum	.	.	.	$1/2^{2-3}$	.	.	.
Elaphomyces anthracinus	.	.	.	$1/1^{2}$	.	.	.
Galerina vittaeformis	.	.	.	$1/1^{1}$	.	.	.
Rhodophyllus juncinus	.	.	.	.	$1/1^{1}$	.	.
Cortinarius tabularis	.	.	.	.	$1/1^{1}$	.	.
Cortinarius elatior	.	.	.	.	.	$1/2^{1}$	.
Cortinarius paleaceus	.	.	.	.	.	$1/1^{2}$	.
Cortinarius pseudosalor	.	.	.	.	.	$1/1^{1}$	.
Boletus calopus	.	.	.	.	.	$1/1^{1}$	.
Craterellus cornucopioides	.	.	.	.	.	$1/2^{2}$	$1/1^{2}$
Amanita phalloides	.	.	.	.	.	.	$1/2^{1}$
Lactarius decipiens	.	.	.	.	.	.	$1/1^{1}$
Inocybe calospora	.	.	.	.	.	.	$1/1^{1}$

the order *Fagetalia*, and some species are connected with the pine, which occurred in the neighbourhood of the area studied. Owing to the deficit of litter and rotten wood, the number of fungal species developing on these substrates was relatively low (Table 3b). No fruit bodes of fungi characteristic of fertile beech forests were found.

A similar community in the Beech Forest near Szczecin was distinguished by Celiński (1962, 1965) as *Fago-Quercetum* variant with *Mnium hornum*. It also occupies steep western and south-western slopes in the zone of the terminal moraine. The soil has a compact structure and shows distinct podsolisation. Acidophilous mosses form a thick carpet in this acid habitat. The floristic composition of this community in the Beech Forest is far more rich in species, particularly photophilous ones, than that of Wolin Island. The contribution of *Quercus robur* is relatively high here.

As regards the mycoflora, the plot established in the mossy patch of

Table 3b

Macromycetes recorded in acidophilous oak-beech forests

Form		with grasses	with mosses					
Locality		Wol. Park Nar.	Wol. Park Nar.	Puszcza Bukowa	Puszcza Darżl.	Gardna	Zamkowa Góra	Kąty
Number of plots		10	2	1	1	1	1	1
Number of observations on the plots		50	10	5	5	3	7	20
Number of species	B	7	7	3	7	2	3	2
	C	26	12	7	13	13	7	5
1		2	3	4	5	6	7	8

B. Fungi on fallen leaves and fruits

Dasyscyphus virgineus	$8/16^{2}$	$2/4^{2}$	$1/1^{1}$	$1/2^{2}$	.	$1/2^{1}$	$1/1^{2}$
Collybia peronata	$10/16^{1-2}$	$1/3^{1}$	$1/3^{1}$	$1/2^{1}$	$1/1^{1}$	$1/1^{1}$	.
Mycena mucor	$6/12^{2}$	$1/2^{2}$	.	$1/1^{2}$	–	.	.
Mycena sanguinolenta	$2/2^{1}$	.	$1/3^{1}$	$1/2^{1}$	.	$1/1^{2}$	.
Mycena stylobates	$3/8^{1}$	$2/4^{1}$	.	.	.	.	.
Collybia confluens	$2/4^{2}$	.	.	.	.	.	.
Mycena pelianthina	$1/1^{1}$	.	.	.	.	.	.
Rhodophyllus mammosus	.	$1/1^{1}$	.	.	.	.	.
Auriscalpium vulgare	.	$1/1^{1}$	.	.	.	.	.
Marasmius androsaceus	.	$1/2^{1-2}$	.	$1/1^{1}$	.	.	.
Marasmius splachnoides	.	.	.	$1/1^{1}$	.	.	.
Phaeomarasmius carpophilus	.	.	.	$1/1^{1}$	.	.	.
Collybia butyracea var. asema	.	.	.	.	$1/2^{1}$	.	.
Collybia butyracea var. butyracea	.	.	.	.	$1/1^{1}$	.	.

1	2	3	4	5	66	7	8
	C. Xylophilous fungi						
a/ on fallen twigs and branches							
Mycena vitilis	$4/8^1$	$1/1^1$	.	.	$1/1^1$	$1/1^1$	.
Crucibulum laeve	$1/1^1$	$1/1^1$	.	.	$1/1^1$	$1/1^1$	.
Cyathus striatus	$1/1^1$	.	.	$1/1^2$	.	.	$1/1^1$
Marasmius alliaceus var.alliaceus	$1/2^1$	.	$1/1^*$	.	.	.	.
Marasmius rotula	$2/8^{1-2}$	.	.	.	.	.	.
Pluteus cinereo-fuscus	$1/1^1$	.	.	.	.	.	.
Mycena acicula	$1/1^1$	.	.	.	.	.	.
Polyporus varius var.nummularius	$2/2^1$	$1/1^1$	.	.	.	.	.
Tremella mesenterica	$1/1^1$	$1/2^1$	.	.	.	.	.
Phaeomarasmius erinaceus	.	$1/1^1$	.	.	.	.	.
Mycena rorida	.	.	.	$1/1^1$	.	$1/1^1$	.
Crepidotus variabilis	.	.	.	.	.	.	$1/1^2$
b/ on stumps and logs							
Hypholoma fasciculare	$6/14^2$	$2/4^{1-2}$	$1/3^{1-2}$	.	$1/1^2$	.	.
Xylosphaera hypoxylon	$4/x^2$	.	$1/x^2$	$1/x^2$	$1/x^2$	$1/x^2$	.
Armillariella mellea	$3/18^2$	.	$1/1^2$	.	$1/1^1$	$1/4^2$	.
Pluteus cervinus ss. Lange	$3/8^1$	$1/1^1$	$1/2^1$	$1/1^1$	$1/1^1$	.	.
Hypholoma sublateritium	$2/4^2$	.	.	$1/1^2$	$1/2^2$	.	.
Oudemansiella platyphylla	$2/3^1$	$1/1^1$	.	.	.	$1/1^1$	.
Ustulina deusta	$2/x^2$	$1/x^1$	.	$1/x^2$	.	.	.
Trametes versicolor	$1/x^2$	.	..	$1/x^2$	$1/x^2$	.	.
Kuehneromyces mutabilis	1/2	$1/2^2$	.	$1/2^2$	.	.	.
Mycena galericulata	$1/2^2$	.	.	.	$1/1^1$	.	.
Coryne sarcoides	$2/4^2$	.	.	.	.	.	.
Calocera viscosa	$2/4^1$	.	.	.	.	.	.
Mycena inclinata	$1/2^3$	.	.	.	.	.	.
Tricholomopsis rutilans	$1/2^1$	.	.	.	.	.	.
Paxillus atrotomentosus	$1/1^1$	.	.	.	.	.	.
Mycena alcalina	.	.	.	$1/1^1$	.	.	.
Panellus stypticus	.	.	.	$1/1^3$	$1/1^2$	.	.
Bjerkandera adusta	.	.	.	$1/x^2$	$1/x^2$	.	.
Psathyrella hydrophila	.	.	.	.	$1/1^2$	.	.
Ganoderma applanatum	.	.	.	.	$1/x^1$	.	.
Bulgaria inquinans	.	.	.	.	.	$1/1^2$	.
Collybia succinea	.	.	.	.	.	.	$1/1^1$
c/ on trunks and roots							
Oudemansiella radicata var. radicata	$5/12^1$	$1/3^1$	$1/2^1$	$1/1^1$	$1/1^1$	.	$1/2^1$
Sparassis crispa	$1/1^1$	.	.	.	.	.	.
Collybia fusipes	.	$1/1^1$	.	.	.	.	.
Oudemansiella mucida	.	.	.	.	.	$1/1^2$	.
Pholiota squarrosa	.	.	.	.	.	.	$1/2^2$

this acidophilous community in the Beech Forest differs slightly from that in the mossy patch on Wolin Island. It is only somewhat richer in fungal species characteristic of deciduous forests, such as *Lactarius piperatus*, *L. pallidus*, *Russula densifolia*, *Clavulina cristata* and *C. cinerea*, which were not found is the similar community on Wolin Island. On the other hand, it exhibits the same group of species distinguishing all the mossy communities of acidophilous oak-beech forests.

Other plots in the mossy communities of the oak-beech forest, classified to the *Trientali-Fagetum* association, had both similar floristic and habitat conditions, reflected in the macromycete flora. These plots were established in the Slovinian National Park near Gardna, in Gdańsk Province — in the Darżlubsk Forest, in the Kashubian Lakeland — in the Zamkowa Góra reservation and in the northern part of Poznań Province — in the forest district Kąty (Tables 3a, b).

MYCOFLORA OF BEECH FORESTS OF OTHER AREAS WITHIN THE GEOGRAPHICAL DISTRIBUTION OF FAGUS IN EUROPE

Mycological studies on fungi of beech forests in central Europe were carried out by a number of authors, but relatively few works report results of observations obtained using mycosociological methods. Publications of a floristic character include lists of fungal species found in beech, oak-beech or fir-beech forest communities in various countries within the range of beech in Europe and provide valuable comparative material, under condition that the forest communities examined are determined from the phytosociological standpoint. All the available mycological works of this character were used in the present chapter.

1. Fungi of beech and beech-oak forests in the northern part of the *Fagus* area

The mycoflora of beech forests of north-western Poland, as regards its specific composition, is most similar to that of beech forests in Denmark.

Forests occupy only a small area in Denmark, almost half of them are deciduos, mainly beech, forests. With the exception of Jutland, where the climatic and edaphic conditions hinder the development of beech, and some islands in the Baltic lying beyond the range of this tree species, beech forests are distributed all over the country. The best preserved beech forest stands occur in the southern parts of the islands and in south-eastern Jutland (Ostenfeld 1932).

Fertile beech forests, which may be classified to the *Melico-Fagetum* association, occur on somewhat dried brown soils with the pH value about 6, on sites protected against winds. On the other hand, acidophilous beech forests with a high contribution of mosses have developed along the coasts, on low slopes exposed to the strong activity of winds. The latter forests are found on dried, compact, sandy soils with a raw humus layer of pH about 4.

Mycological studies were performed in the *Melico-Fagetum* association on 10 plots, of 400 sq m each, established in the south-eastern part of Fyn Island and on Zealand Island in the environs of Sorö and Köge as well as on 2 plots chosen in the mossy, acidophilous beech forest on the Fyn Island (Lange, Lisiewska 1969).

In the *Melico-Fagetum* association the tree stand consists almost entirely of beech, whereas the extremely scarce shrub layer is formed chiefly by beech with a sycamore admixture. In the field layer, on some sites *Melica uniflora* or *Asperula odorata* are dominants, and *Mercurialis perennis*, *Anemone nemorosa*, *Viola silvestris*, *Oxalis acetosella* and other species are less abundant.

In the patches of this association was observed the highest number of macromycetes found also on plots of *Melico-Fagetum* in north-western Poland — 76 per cent of species common (Table 5). Analysis of terrestrial fungi of both areas compared demonstrate a relatively numerous group of fungi found in all the patches of fertile beech forest on Pomerania and in Denmark. *Psathyrella gracilis*, *Coprinus silvaticus*, *C. picaceus*, *Helvella crispa*, *Stropharia squamosa*, *Russula solaris*, *R. grisea* var. *xanthochlora*, *R. veternosa* and other species (Table 4a, Nos. 16, 17) belong to this group. The group of fungi developing fruit bodies on fallen leaves and fruits generally possess a wider ecological range, therefore no species occurring exclusively on both areas compared were observed here (Table 4b, Nos. 16, 17). On the other hand, of those fungi fruiting on fallen twigs and branches, two note worthy species were observed mainly in the northern beech forests within the distributional range of beech in Europe. The first — *Hydropus subalpinus* was found on fallen beech twigs in the *Melico-Fagetum* association both in Denmark and in Western Pomerania, whereas in areas further south it was reported only recently by Salata (1972) from beech forests of Central Roztocze (south-eastern Poland) and by Šmarda (1969) from south-western Moravia. *Polyporus forquignoni* is the second rare species observed by the present author in several patches of *Melico-Fagetum* in Denmark and in beech forests of Rügen Island and Darss Peninsula (unpublished data). In Poland, it was hitherto unknown (Domański, Orłoś, Skirgiełło 1967) *. Most of the common species are macromycetes found in beech forests and related associations of the order *Fagetalia* in various European countries.

The acidophilous forest, probably belonging to the *Trientali-Fagetum* association, was the next beech forest association compared in Denmark. The tree stand is formed of beeches with a characteristic habit. They are relatively low, strongly ramified, with thick, fantastically twisted trunks. The shrub layer is entirely absent. The very poor field layer consists

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* The author, together with dr hab. H. Kreisel, found two specimens of *Polyporus forquignoni* in *Melico-Fagetum cephalantheretosum rubrae* on Wolin Island in June 1972 and then in October this year.

mainly of rare tufts of *Deschampsia flexuosa* and *Poa nemoralis*. *Mnium hornum* predominates in the compact moss layer. Terrestrial fungi played the main role in this community, in which the litter was blown away by winds and rotten wood occurred only on some sites. Besides bryophilous species, such as *Galerina hypnorum*, *Gerronema fibula* and *G. setipes*, fungi from habitats with an acid reaction, e.g. *Russula vesca*, *R. mairei*, *R. alutacea*, *Boletus erythropus*, *B. appendiculatus*, *B. calopus*, *Tricholoma ustale* and *Cantharallus cibarius* (in masses) were also found fruiting abundantly. Most of the species quoted also characterized the acidophilous oak-beech forests in Western Pomerania.

The work of Jahn, Nespiak and Tüxen (1967) concerning the contribution of macromycetes to the beech forests of Wesergebirge provides interesting comparative material. These authors carried out studies over several years, applying phytosociological methods, on 20 permenent plots established in the following associations: *Carici-Fagetum*, *Melico-Fagetum* and *Luzulo-Fagetum*.

Patches of the association *Carici-Fagetum* (suballiance *Cephalanthero-Fagion*) occur on steep, southern slopes of hills reaching the altitude of 300 m a.s.l. In Wesergebirge this association is confined to intensively insolated sites on calcareous substrate. It includes many thermophilous vascular plants such as: *Sorbus torminalis*, *Daphne mezereum*, *Campanula persicifolia*, *Carex digitata*, *Brachypodium silvaticum* and several orchid species. The number of macromycetes found in this association is twice as large as that of higher plants. Of 89 fungal species found, the 39 species connected exclusively or almost exclusively with calcareous soils and soils rich in nutrient components are noteworthy. These are thermophilous fungi recorded in southern and central Europe. *Boletus satanas*, further to the north noted on Rügen Island in a beech forest on the chalk cliff (Kreisel 1960) and on Usedom Island on a similar substratum (Stier 1931, 1933, 1939), was the most important species and the authors accepted it as locally diagnostic for the *Carici-Fagetum* in Wesergebirge. In Poland this species has not been observed for many years (Skirgiełło 1960). *Tricholoma pardinum*, *Cortinarius cotoneus*, *Albatrellus cristatus*, *Ramaria aurea*, *Russula olivacea* and *R. maculata* are also calcicole species. Some of them were found in the orchid beech forest subassociation observed on Wolin Island and were also observed on calcareous substratum in beech forests in south-eastern Poland, Austria and Yugoslavia. Only a few fungal species fructifying on fallen leaves and a single xylophilous species — *Oudemansiella radicata*, were observed in the *Carici-Fagetum* association.

Melico-Fagetum, divided into several subassociations, is the most wide spread beech forest community in Wesergebirge. The fungal species found in the subassociations *M.-F. alietosum* and *M.-F. typicum* are

TABLE 42

ECOLOGICAL RANGE OF MORE IMPORTANT BEECH FORESTS MACROMYCETES

A. FRUIT BODIES ON THE GROUND

	LOWLAND FORESTS																										UPLAND AND MOUNTAIN FORESTS																
PHYTOSOCIOLOGICAL UNIT	[illegible]			GALL.-CARP.				TILIO-CARP.				CAR. FAG.	ACE. FAG.	MELICO-FAGETUM							ACIDOPHILOUS CAR.-BEECH FORESTS					PINO-QUERC.	DENTARIO GLANDULOSAE-FAGETUM					[illegible]			ABIETI-FAGETUM		LUZULO-FAGETUM			[illegible]	ABIETETUM POLON.		
LOCALITY	N. POLAND (POMORZE)			N. POLAND (WIELKOPOLSKA)				C. POLAND (ŁÓDZKIE)			[illegible]	[illegible]	N. POL.	[illegible]	N. POLAND		[illegible]		N. POLAND		[illegible]	N. POL.	[illegible]	N. POL.	[illegible]	N. POL.	S. POLAND										S. POLAND				S. POLAND		
NUMBER OF PLOTS	1	2	4	8	7	6	4	13	8	4	2	1	3	2	1	[illegible]	10	6	4	1	4	10	5	7	2	11	16	2	4	3	9	5	11	5	6	2	4	1	3	1	7	2	13
TOTAL NUMBER OF OBSERVATIONS ON THE PLOTS	50	20	40	[illegible]	160	128	110	299	180	68	35	12	17	11	8	134	35	40	33	8	40	50	45	50	15	18	16	100	250	50	300	60	47	5	6	3	4	35	3	1	200	36	13
CONSECUTIVE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
BOLETUS SATANAS												1																															
TRICHOLOMA PARDINUM												1																					1								1		
CORTINARIUS COTONEUS												1															1																
ALBATRELLUS CRISTATUS												1																															
RAMARIA AUREA												1											1				1						1		1				2	1			II
INOCYBE PETIGINOSA						+						1				1							II				1					III					1						
RUSSULA OLIVACEA												1				1			1				II								1		1			2			2		1		
RUSSULA MACULATA												1			1																					1							
BOLETUS LURIDUS								1				1			1	1	1						II									1	1										
CORTINARIUS LARGUS															1												1						II										
LEPIOTA PSEUDO-FELINA													2						+																								
LYOPHYLLUM CONNATUM													2																		II												
LEPIOTA HETIERIANA													1																														
TUBARIA MINUTALIS													1			+	+																										
NAUCORIA SUBCONSPERSA	1	1	2										1																														
NAUCORIA SCOLECINA	1	1	2	+				1					1																														
GALERA TENERA f. MINOR													2																														
SS. LANGE		1	2	1		1							2																														
LACCARIA TORTILIS		1	1										1				+																						1				
PHOLIOTINA MAIREI			1	1	1								1																														
COPRINUS SILVATICUS					1								1	+		1	II																										
PSATHYRELLA GRACILIS				II	II	I	1	III					1		1	II	III												2														
COPRINUS PICACEUS				1		IV									1	III	V														1												
HELVELLA CRISPA					1	1		+							1	1	II					1				+				1													+
ALEURIA AURANTIA															1	1	1		1								1			1													
BOLETUS ERYTHROPUS											1	1			1	1	II		2	1		1	1	1	1		1	1		1	II				1	1				1	III	1	II
AMANITA PHALLOIDES				II	III	IV	2	V	II	2	1					1	1						III	1			1			1	IV	II				1					I		
LEPISTA NUDA				II	IV	III	3	V	IV	2	2					1	1					1						1			III										II		
CLITOCYBE NEBULARIS				I	II	II	3	IV	IV	3	1					II	1	II				1							3		III	II									1		
RUSSULA VIRESCENS					II	II	1	V	IV	2						1	1											1					II	1		1			1	1			
STROPHARIA SQUAMOSA								II								II	II					1									II												
MUTINUS CANINUS						1											III	II			2														1								
RUSSULA SOLARIS				+												1	III														III			1	II				2				
RUSSULA GRISEA VAR. XANTHOCHLORA SS. LANGE																1	II						1		1										II								
RUSSULA VESCA							1									II	II		1																	1			1				
BOLETUS APPENDICULATUS																1	1								2																		
STROBILOMYCES FLOCCOPUS											1					1	1										1	1		1	II						1				II		
RUSSULA CYANOXANTHA					+																																						
f. ATROVIOLACEA SS. LANGE																1			2	1																							
GYROPORUS CYANESCENS																1												1			1					1			1		1		
CLAVARIADELPHUS PISTILLARIS								1				1				1			1				II										V										
[illegible]																	[illegible]																										

COPRINUS PICACEUS	[illegible]
HELVELLA CRISPA	[illegible]
ALEURIA AURANTIA	[illegible]
BOLETUS ERYTHROPUS	[illegible]
AMANITA PHALLOIDES	[illegible]
LEPISTA NUDA	[illegible]
CLITOCYBE NEBULARIS	[illegible]
RUSSULA VIRESCENS	[illegible]
STROPHARIA SQUAMOSA	[illegible]
MUTINUS CANINUS	[illegible]
RUSSULA SOLARIS	[illegible]
RUSSULA GRISEA MAL.	[illegible]
XANTHOCHROA SS. LANGE	[illegible]
RUSSULA VELENOVSKYI	[illegible]
BOLETUS APPENDICULATUS	[illegible]
STROBILOMYCES FLOCCOPUS	[illegible]
RUSSULA CYANOXANTHA	[illegible]
F. ATROVIOLACEA SS. LANGE	[illegible]
GYROPORUS CYANESCENS	[illegible]
CLAVARIADELPHUS PISTILLARIS	[illegible]
GERRONEMA FIBULA	[illegible]
GALERINA HYPNORUM	[illegible]
CYSTODERMA AMIANTHINUM	[illegible]
DERMOCYBE CINNAMOMEOLUTEA	[illegible]
CANTHARELLUS TUBAEFORMIS	[illegible]
GALERINA MNIOPHILA	[illegible]
CORTINARIUS COLLINITUS	[illegible]
DERMOCYBE SEMISANGUINEA	[illegible]
BOLETUS CALOPUS	[illegible]
TRICHOLOMA USTALE	[illegible]
RUSSULA VESCA	[illegible]
CORDYCEPS OPHIOGLOSSOIDES	[illegible]
ELAPHOMYCES GRANULATUS	[illegible]
CANTHARELLUS CINEREUS	[illegible]
PORPHYRELLUS PSEUDOSCABER	[illegible]
CORTINARIUS NEMORENSIS	[illegible]
CORTINARIUS TORVUS	[illegible]
HYGROPHORUS PUDORINUS	[illegible]
PHYLLOPORUS RHODOXANTHUS	[illegible]
LACTARIUS GLAUCESCENS	[illegible]
SARCOSPHAERA EXIMIA	[illegible]
GEASTRUM TRIPLEX	[illegible]
LACTARIUS BLENNIUS	[illegible]
RUSSULA MAIREI	[illegible]
HYGROPHORUS EBURNEUS	[illegible]
LACTARIUS PIPERATUS SS. NEUHOFF	[illegible]
PHALLUS IMPUDICUS	[illegible]
LACTARIUS PALLIDUS	[illegible]
RUSSULA LEPIDA	[illegible]
RUSSULA ALUTACEA	[illegible]
CRATERELLUS CORNUCOPIOIDES	[illegible]
LACTARIUS VELLEREUS	[illegible]
LACTARIUS SUBDULCIS	[illegible]
RUSSULA NIGRICANS	[illegible]
RUSSULA FELLEA	[illegible]
TRICHOLOMA SULPHUREUM	[illegible]
RUSSULA CYANOXANTHA F. CYANOXANTHA	[illegible]

TABLE 4b

ECOLOGICAL RANGE OF MORE IMPORTANT BEECH FORESTS MACROMYCETES

B. FRUIT BODIES ON FALLEN LEAVES AND FRUITS

	LOWLAND FORESTS																									UPLAND AND MOUNTAIN FORESTS																	
PHYTOSOCIOLOGICAL UNIT	CE-A	C-A	CR-F	GALIO-CARP.				TILIO-CARP.				CAR-FAG.	MER-FAG.	MELICO-FAGETUM							ACIDOPHILOUS OAK-BEECH FORESTS					PINO-QUER.	DENTARIO GLANDULOSAE-FAGETUM					DENT. ENN. FAG.	FAG. PRAE-ALP.	FAG. MONT. SERB.	ABIETI-FAGETUM		LUZULO-FAGETUM			MU-SCO-FAG.	ABIETETUM POLON.		
				COR.	STACH. TYP.	STACH. WITH FAG.	LATH.	STACH.	TYP.	CAL.	WITH ABIES			ALL.	CEPH.	TYPICUM			FEST.	CAL.	WITH GRASSES		WITH MOSSES																				
LOCALITY	N-POLAND (POMORZE)			W-POLAND (WIELKOPOLSKA)				C-POLAND (ŁÓDZKIE)			SNP	G	N-POL.	G	N-POLAND		D	G	N-POLAND		G	N-POL.	G	N-POL.	D	N-POL.	SE-POLAND: BESZ.	BESK. SĄD.	ONP	ŚNP	ROZT.	JURA KRAK.	A	J SERBIA		J BOS.	SE-POLAND: BESZ.	BESK. SĄD.	J BOS.	J SERB.	SE-POLAND: ROZT.	SNP	SUB-NE
NUMBER OF PLOTS	1	2	4	6	7	6	4	13	8	4	2	1	3	2	1	25	10	6	4	1	4	10	5	7	2	11	16	2	4	3	9	5	11	5	6	3	4	1	3	1	7	2	13
TOTAL NUMBER OF OBSERVATIONS ON THE PLOTS	10	20	40	212	160	138	110	299	180	68	35	10	21	15	8	134	35	40	38	6	40	50	45	50	15	28	16	100	258	50	300	68	47	5	6	3	4	25	3	1	100	35	53
CONSECUTIVE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
MARASMIUS SPLACHNOIDES					I	I						1				II			1	1				I	1	1																	
MARASMIUS RECUBANS				I									3		1	I				1																							
TUBARIA PELLUCIDA			1													I	I		3	1										I												2	
MYCENA MUCOR				I				III	III	2						III			2	1		III		III																			
MYCENA AMICTA																I	I								1				1				1										
PHAEOMARASMIUS CARPOPHILUS						II	1								1	II	I	I	1	1			I	I					4	2													
DASYSCYPHUS VIRGINEUS	+		+	I		III							1		1	V			4	1		IV	II	IV						3	V										II		
MYCENA PELIANTHINA					I	II		I							1	I	III					I			1			1	4	1	V	1	1				2				I		
MYCENA FAGETORUM																I												2										1					
COLLYBIA FUSCOPURPUREA																		I										1		1	II									1			
XYLOSPHAERA CARPOPHILA			+													I	I												1		V	1									I		
MYCENA CAPILLARIS	+	+	+			I																I						1	3	3	IV	II						1					
MARASMIUS PRASIOSMUS						I																				I	I	1	1	1													
CLITOCYBE FRAGRANS					I	III	2		I		1		1			I											I			1							1					1	
CLITOCYBE HYDROGRAMMA				I				III	I	2						I	II			1	2						II			1			I										I
CLITOCYBE ODORA				II	II	III	3	I	II				1		1	II	I	I	2								II		2	1	IV						·	·					I
MARASMIUS BULLIARDII				II	II	II	1	I	I				1		1	I	III										I			2	IV				I						II		
COLLYBIA BUTYRACEA VAR. ASEMA				I	II	IV		V	V	4				1		II	III	I	2	1	1		I	I	1		II	2		2	I		II				1				III	2	I
MYCENA STYLOBATES				I	I	II	1		I					1		II	I	II	1		2	II		II			II	2		2	IV			I			1			1	III		
COLLYBIA PERONATA				II	III	IV	3	V	V	2	2		1	1	1	IV	IV	IV	4	1	4	V	II	IV	1	II	II		2	3	V	II	IV								III		I
MYCENA FILOPES			2	I	II	III	II	III	IV	1			2			II	II		1	1							II	1			IV		1				1					1	

TABLE 4c

ECOLOGICAL RANGE OF MORE IMPORTANT BEECH FORESTS MACROMYCETES

C. FRUIT BODIES ON WOOD

	LOWLAND FORESTS																										UPLAND AND MOUNTAIN FORESTS																
PHYTOSOCIOLOGICAL UNIT	CE A	C A	CE F	GALIO-CARP.				TILIO-CARP.				CAR FAG	MER FAG	MELICO-FAGETUM							ACIDOPHILOUS OAK-BEECH FORESTS					PINO QUER	DENTARIO GLANDULOSAE-FAGETUM					[illegible] FAG	CAR PRAE ALP	FAG MOES SERB	ABIETI-FAGETUM		LUZULO-FAGETUM			[illegible] FAG	ABIETETUM POLON.		
				COR.	STACH TYP	STACH WITH ABI FAG	LUTH.	STACH	TYP	CAL.	WITH ABIES			ALL	CEDR	TYPICUM			FEST	CAL	WITH GRASSES		WITH MOSSES																				
LOCALITY	N-POLAND (POMORZE)			W-POLAND (WIELKOPOLSKA)				C-POLAND (ŁÓDŹ)			ŚWP	G	N-POL	[illegible]	N-POLAND		D	G	N-POLAND		G	N-POL	G	N-POL	D	N-POL	SE-POLAND BIESZ	BUK CAR	ONP	ŚWP	ROZT	JURA KRAK	A	J SERBIA		J DOB	SE-POLAND BIESZ	BESK SAD	J DOB	J SERB	SE-POLAND ROZT	ŚWP	DUB ME
NUMBER OF PLOTS	1	2	4	6	7	6	4	13	6	4	2	1	3	2	1	25	10	6	4	1	4	10	5	7	2	11	16	2	4	3	9	5	11	5	6	3	4	1	3	1	7	2	13
TOTAL NUMBER OF OBSERVATIONS ON THE PLOTS	10	20	40	212	160	138	110	289	180	60	35	10	21	15	8	134	30	40	25	6	40	30	45	50	15	28	16	100	258	50	300	68	47	5	6	3	4	35	3	1	200	36	13
CONSECUTIVE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
a) ON FALLEN TWIGS AND BRANCHES																																											
HYDROPUS SUBALPINUS													2			II	III		1												III												
POLYPORUS FORQUIGNONI															1		III																										
MARASMIUS ALLIACEUS VAR. ALLIACEUS	+		+										3	1	1	IV	IV		4	1		1		+			IV	1		3	V	II	II	III	IV	2	4	1	1		II		
MYCENA CROCATA	+		+										2		1	III	IV		2	1							III	1			IV					1	3		1		I		
MARASMIUS ALLIACEUS VAR. SUBTILIS SS LANGE													1		1		I			1										1						1							
PYCNOPORUS CINNABARINUS																			1								I												1				
PSATHYRELLA FUSCA				I		I										+	II		1												II												
POLYPORUS VARIUS VAR. NUMMULARIUS			+	I	II	II		II					3		1	III	III	II	2	1		II		I		I	II		3		V			II	II	1	1		2		+		
MARASMIUS ROTULA			1	V	V	V	4	IV					3		1	III	III		3			II			1		II		1	2	V		II	I	III		1						
TREMELLA MESENTERICA			1	II	II	II	2	III	II	1	1					I	II					I		1	1		I	1	1	2		I										2	
MYCENA VITILIS	+		2	V	V	V	3	V	IV	1	1		2		1	IV	IV		1	1		IV		III	1	II	I	1		3	V	I	I		I			I					
b) ON STUMPS AND LOGS																																											
PLUTEUS LEONINUS															1	I			1								II			1													
TRAMETES GIBBOSA																II	1		2								III				II			III	III								
GANODERMA APPLANATUM			+		I			I								I			2	1			I	I			IV	1	1	1	II	II		III	II	3	2		2			1	1
USTULINA DEUSTA				I				I		I					1	II	III		3	1		II		II			III		1	3	II	V		V	III	2		1	3		+		
HERICIUM CORALLOIDES																											II		1	1	IV												
INONOTUS RADIATUS VAR. NODULOSUS																											II		1		III												
OMPHALINA EPICHYSIUM																											I			3													
STEREUM INSIGNITUM																																		V	V	3				1			
AURICULARIA MESENTERICA																											I							I	III								
XYLOSPHAERA POLYMORPHA				III	I			I					2	1		I	III	IV					I				I		1	1	IV	V		III	I	1					1		
KUEHNEROMYCES MUTABILIS					III	II	1		I	1			2	2	1	III	IV	II	2	1	2	I	II	II		I	II		1	1	I	I	I		II	1	1	1				1	
CORYNE SARCOIDES		1	1					III		2						I	I					II	II				II			1	II	I											
OUDEMANSIELLA PLATYPHYLLA		+	+		I	III		II	II		1		2	2	1	II	V	IV	1		4	II	IV	II	1		III		1	2	III		1	II	II	1					+	1	1
MYCENA HAEMATOPODA	1	1			I						1		1			I	II	I									II				II												
PLUTEUS CERVINUS	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					

CONSECUTIVE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
a) ON FALLEN TWIGS AND BRANCHES																																											
HYDROPUS SUBALPINUS													2			II	III		1												III												
POLYPORUS FORQUIGNONI															1		II																										
MARASMIUS ALLIACEUS VAR. ALLIACEUS	+		1										3	1	1	IV	IV		4	1		1		+			IV	1		3	V	II	II	III	IV	2	4	1	1		II		
MYCENA CROCATA	+		+										2		1	III	IV		2	1							III	1			IV					1	3		1		I		
MARASMIUS ALLIACEUS VAR. SUBTILIS SS LANGE													1		1		1			1										1						1							
PYCNOPORUS CINNABARINUS																			1								1												1				
PSATHYRELLA FUSCA				I		1										I	II		1												II												
POLYPORUS VARIUS VAR. NUMMULARIUS			+	I	II	II		II					3		1	III	III	II	2	1		II		1		1	II		3		V			II	II	1	1		2		+		
MARASMIUS ROTULA			1	V	V	V	4	IV					3		1	III	III		3			II			1		II		1	2	V		II	I	III		1						
TREMELLA MESENTERICA			1	II	II	II	2	III	II	1	1					I	II					1		1	1		I	1	1	2		1										2	
MYCENA VITILIS	+		2	V	V	V	3	V	IV	1	1		2		1	IV	IV		1	1		IV		III	1	II	I	1		3	V	1	1		1			1					
b) ON STUMPS AND LOGS																																											
PLUTEUS LEONINUS															1	1			1								II			1													
TRAMETES GIBBOSA																III	1		2								II				II			III	III								
GANODERMA APPLANATUM			+		I			I								I			2	1			1	1			IV	1	1	1	II	II		III	II	3	2		2			1	1
USTULINA DEUSTA				1				1		1					1	II	III		3	1		II		II			III		1	3	III	V		V	III	2		1	3		+		
HERICIUM CORALLOIDES																											II		1	1	IV												
INONOTUS RADIATUS VAR. NODULOSUS																											II		1		III												
OMPHALINA EPICHYSIUM																											1			3													
STEREUM INSIGNITUM																																		V	V	3				1			
AURICULARIA MESENTERICA																											I							I	III								
XYLOSPHAERA POLYMORPHA				III	I			1					2	1		I	III	IV					I				I		1	1	IV	V		III	I	1					1		
KUEHNEROMYCES MUTABILIS					III	II	1		1	1			2	2	1	III	IV	II	2	1	2	I	II	II		1	III		1	1	I	I	I		II	1	1	1				1	
CORYNE SARCOIDES		1	1					III		2						I	I					II	II				II			1	II	I											
OUDEMANSIELLA PLATYPHYLLA		+	+		I	III		II	II		1		2	2	1	II	V	IV	1		4	II	IV	II	1		III		1	2	III		I	II	II	1					+	1	1
MYCENA HAEMATOPODA	1	1			I						1		1			I	II	I									II				II												
PLUTEUS CERVINUS	1			IV	IV	III	3	V	III	2	1		1		1	III	IV	II	2	1	1	III	III	III		II	II	1	2	2	IV	IV	II	I	II	1	2	1			+		III
MYCENA GALERICULATA	1	1	2	IV	V	IV	4	V	V	2	1		3	2	1	II	III	II	3	1	1	I	IV	I	1		III		3			1			1								1
c) ON TRUNKS AND ROOTS																																											
POLYPORUS MELANOPUS															1	1											I																
MERIPILUS GIGANTEUS																	II				2										I			II									
PHOLIOTA SQUARROSA																I		1						I			I			1		I	I				1						I
PHOLIOTA AURIVELLA											1					I											I	1		1	III	I						1				1	II
OUDEMANSIELLA MUCIDA						I							1		1	I	II		2					I	1		II		1		IV	I	II	I			1				+		
OUDEMANSIELLA RADICATA VAR. GRACILIS SS. LANGE					I	II									1	I			2											3												+	
COLLYBIA FUSIPES					I	I								1		I	I	1	1					I																			
FOMES FOMENTARIUS		+			I	I		1								II	1		4	1							IV	1	4	2	II	I		IV	IV	2	2		2		+		
OUDEMANSIELLA RADICATA VAR. RADICATA				III	III	V	2	III	II	1		1	3	2	1	IV	V	V	3	1	4	III	IV	IV	1		III	2	4	3	V	V	V	V	II	1	3	1		1	+		

summarized for comparative purposes in Table 4 (Nos. 14, 18). Apart from the *Carici-Fagetum* association, the patches of *Melico-Fagetum* having a dense (particularly when *Allium ursinum* predominates) field layer, were very poor in terrestrial fungi and no distinguishing species for these subassociations have been selected (Table 4a, Nos. 14, 18). On the other hand, fungi fructifying on fallen leaves and wood were more numerous. However, these species have a wider ecological distribution (Tables 4b, c: Nos. 14, 18). The number of species common for the *Melico-Fagetum* in Pomerania and in Wesergebirge is relatively high and amounts to 70 per cent.

The community of the acidophilous beech forest — *Luzulo-Fagetum* occurs on less fertile, and more acid substratum (Jahn, Nespiak, Tüxen 1967). These authors distinguished several subassociations. For comparative purposes, these subassociations are classified into two groups: *Luzulo-Fagetum festucetosum altissimae, Luzulo-Fagetum caricetosum* and *Luzulo-Fagetum dryopteridetosum* belong to the first group, in which herbaceous plants, mainly grasses, predominate. *Luzulo-Fagetum leucobryetosum* and *Luzulo-Fagetum typicum* belong to the second group having a well developed moss layer. Mycosociological records of these communities are compared in Table 4 (Nos. 21, 23) with the records from acidophilous oak-beech forests of north-western Poland and Denmark, since, as regards the mycoflora, the acidophilous beech forests of Wesengebirge are more similar to these communities than to the *Luzulo-Fagetum* association from mountains and uplands of southern Poland and Yugoslavia. The grassy form of the association discussed in Wesengebirge was poor in fungi and only *Russula ochroleuca* was more frequent and may be assumed to be the locally diagnostic species (Jahn, Nespiak, Tüxen 1967). On the other hand, the mossy patches belong to the richest in respect to mycoflora (153 macromycetes species) and the ratio of fungal species to vascular plant species is 7:1. Acidophilous species constitute the most abundant group of fungi and the authors accepted them as locally diagnostic. Most of these species are components of the group of species distinguishing the acidophilous beech and oak-beech forests of the northern range of beech in Europe. Calcicole fungi were also observed occasionally in Wesergebirge, e.g. *Russula olivacea, Ramaria aurea, Inocybe petiginosa* (Table 4a, No. 23). They appeared on sites where running rain-water carried calcium from the bordering *Carci-Fagetum* patches situated above the *Luzulo-Fagetum* association.

Sporadic, but interesting mycological notes were made by Nespiak (1966) from the *Carici-Fagetum* and the *Melico-Fagetum* association of the Harz Mts. (environ of Osterrode). These associations of the beech forest occur on gypsum rich substrate, which provides specific conditions for the development of the mycoflora. Thermophilous species, connected with habitats of alkaline reaction, such as *Cortinarius cotoneus* and *Boletus luridus*, and a number of species frequent in fertile beech forest of the northern part of the distribution of *Fagus*, such as *Hydropus subalpinus (Mycena subalpina)* as well as several fungal species rare in Europe were found here.

The beech forests on Rügen Island exhibit a high percentage (71 per cent) of fungal species in common with the Pomeranian beech forest. On Rügen Island they occur on the top part of the cliff, mainly on chalk substrate and because of this, thermophilous and calciphilous species prevail. K r e i s e l (1957b) carried out observations over several years on the macromycete flora of this area. Unfortunately, the results of these studies could not be utilized for comparative purposes in Table 4, since K r e i s e l did not establish permanent plots and gave no phytosociological classification of the forests investigated. The list of fungi includes many species characteristic of fertile lowland beech forests, such as *Clavariadelphus pistillaris, Boletus erythropus, B. luridus, B. appendiculatus, Coprinus picaceus, Marasmius alliaceus, Mycena crocata, Oudemansiella mucida* and several calciphilous species of the genus *Russula*, such as: *R. maculata, R. aurata* and *R. olivacea* observed also in the patch of orchid beech forest on Wolin Island.

The same author described also the mycoflora of acidophilous beech-oak forests, probably belonging to the *Fago-Quercetum* association, occurring on Darss Peninsula (K r e i s e l 1957a). Beside *Fagus sylvatica*, the tree layer of this association consists of *Quercus robur, Betula pubescens, Sorbus aucuparia* and single *Acer pseudoplatanus*. The shrub layer consists of *Ilex aquifolium, Crataegus monogyna* and *Lonicera periclymenum*, whereas *Convallaria maialis, Pteridium aquilinum, Luzula pilosa, Oxalis acetosella* and *Asperula odorata* dominate in the field layer. This community possessed 61 per cent of fungal species in common with the *Melico-Fagetum* association in north-western Poland. Most of these species occur not only in beech forests, but also in related forest associations. Of fungi characteristic of beech forests only the following may be quoted: *Marasmius alliaceus, Coprinus picaceus, Stropharia squamosa* and *Oudemansiella mucida*. The community discussed shows a mycoflora most similar to that of *Fago-Quercetum* in Wolin Island National Park (Table 3).

N e u h o f f (1956) mentions the following fungal species as commonly occurring in beech forests of northern Germany: *Oudemansiella mucida, Collybia fuscopurpurea, Mycena pelianthina, M. fagetorum, Dermocybe cinnabarina, Cortinarius cotoneus, Russula fellea, R. solaris, R. olivacea,* *Clavariadelphus pistillaris, Lacterius blennius, L. pallidus* and *L. subdulcis*. These species were also found in the Pomeranian beech forests studied.

2. Fungi in beech forests of Polish mountains and uplands

In Poland the beech forests reach their eastern distributional limit (Fig. 1). Beside the north-western districts, in which fertile and acidophilous lowland beech forests occur, natural beech forests dominate particularly in the southern and south-eastern upland and mountainous part of Poland.

The best developed fertile mountain beech forests occur in the lower montane zone of the Carpathians and Sudetes as well as in the submontane zone and on the belt of uplands beyond the zone of the Central-Polish glaciation. As compared with lowland beech forests, they are geographically more differentiated and form numerous regional types and altitudinal strata. Moreover, they have a wider differentiation of habitats as well as a richer and more stable composition of characteristic and distinguishing species (W. and A. Matuszkiewicz 1970). The fertile mountain beech forests in Poland are divided into two regional associations: *Dentario glandulosae-Fagetum* and *Dentario enneaphyllidis-Fagetum*, which belong to the *Eu-Fagion* suballiance similary as the fertile lowland beech forest association.

The association of the Carpathian fertile beech forest, *Dentario glandulosae-Fagetum* Klika 1927 emend. Mat. 1964 (= *Fagetum carpaticum* Klika 1927 p.p.) is floristically richer and regionally more differentiated. Fir (*Abies alba*) is a permanent component of the tree layer, white sycamore and spruce constitutes an admixture. Mountain species, such as *Polystichum lobatum, Prenanthes purpurea, Senecio fuchsi, Polygonatum verticillatum* and *Dryopteris austriaca* occur in the field layer, and *Dentaria glandulosa, Polystichum braunii* and *Symphytum cordatum* are characteristic species. This association develops two altitudinal forms: the lower montane — typical form and the submontane form similar to the lowland deciduos forests of the oak-hornbeam type.

The Sudetian fertile beech forest association — *Dentario enneaphyllidis-Fagetum* (Preis 1938) Oberd. 1957 is a distinctly separate regional association. Beside the Sudetes (lower montane zone and submontane zone) this association occurs also on the Silesia Upland, in the northern part of the Cracow—Częstochowa Upland and in the western part of the Świętokrzyskie Mts. Apart from the Carpathian fertile beech forest, *Abies alba* constitutes only an admixture. *Dentaria glandulosa, Polystichum braunii, Euphorbia amygdaloides* and *Salvia glutinosa* are entirely absent in the field layer, whereas *Dentaria enneaphyllos*, *Euphorbia dulcis* and *Asperula odorata* are characteristic species here.

The acidophilous mountain beech forest — *Luzulo-Fagetum* (Du Rietz 1923) Markgr. 1932 emend. Meusel 1937, belonging to the suballiance *Luzulo-Fagion*, occurs on poor habitats in the lower-montane zone and in the submontane zone of the Sudetes and Carpathians. The tree stand here consists mainly of beeches with a contribution of firs and spruces; the shrub layer is mostly composed of beech undergrowth, whereas the field layer generally is weakly developed and consists of grassy (*Luzula nemorosa* var. *albida*, *Deschampsia flexuosa*) and fruticose (*Vaccinium myrtillus*) forms as well as of several mountain herbaceous species. The moss layer is well developed (W. Matuszkiewicz 1967; W. and A. Matuszkiewicz 1970).

Mycological research has been carried out for many years in these associations of mountain beech forest. Those of the Western Bieszczady Mts. are relatively well known and mycosociological records were obtained of the most part from 400 sq m plots. Unfortunately only single observations were made, but they were carried out on numerous sites at the period of peak fructification of fungi in this interesting part of the Eastern Carpathian Mountains (Domański, et al. 1960, 1963, 1967, 1970).

The Carpathian fertile beech forest reaches the upper forest limit in the Western Bieszczady Mts. In addition to the dominant beeches it shows slight admixture of fir and sycamore and an abundantly developed field layer. Particularly favourable conditions for the development of the mycoflora occur in these forests, since they have not been exploited for many years. Because of this, and in contrast to the managed forests on the lowlands, xylophilous fungi played the main role as indicator species (Table 4c, No. 27). Nevertheless, the contribution of macromycetes forming synusiae on the ground and on fallen leaves was also considerable. Fungi of the genera *Lactarius* (e.g. *L. subdulcis*, *L. blennius*), *Russula* (e.g. *R. cyanoxantha*, *R. mairei*) and *Cortinarius* (e.g. *C. anomalus*, *C. elatior*, *C. bolaris*) fructified abundantly. The considerable humidity and intensive shading below the beech canopy favoured the rich growth of fungi. Amongst terrestrial fungi, fruit bodies were observed of several species, not hitherto seen in analogous lowland beech forests. These included *Porphyrellus pseudoscaber* (Skirgiełło 1960) as well as *Cortinarius torvus* and *C. nemorensis*, which may be assumed to belong to the group of fungal species distinguishing fertile mountain beech forests (Table 4a). Rotten leaves constituted a perfect substrate for the development of numerous fungal species of the genera *Collybia*, *Clitocybe*, *Mycena* and *Marasmius*. Amongst the large group of xylophilous fungi present in almost all the patches of the beech forest studied, the abundant fruiting of *Marasmius alliaceus* and *Mycena crocata*, characteristic of lowland mountainous beech forests, was noteworthy. Of the species distinguishing mountain fertile beech forests, fruit bodies of *Hericium coralloides* and *Inonotus radiatus* var. *nodulosus* were found in the Bieszczady Mts. Fungi belonging to the families *Polyporaceae* and *Ganodermataceae* were common in all plots.

Observations in plots of the mountain acidophilous beech forest, *Luzulo-Fagetum*, were less frequent than those carried out in the mountain fertile beech forests, which predominates in the Western Bieszczady Mts. Nevertheless, fruit bodies of a larger number of species of terrestrial fungi were seen on four plots established in the *Luzulo-Fagetum* association than on the plots of fertile beech forest. The following species were most abundant: *Lactarius blennius*, *Craterellus cornucopioides*, *Lactarius vellereus* and *Collybia tuberosa*, whereas species most frequently found in acidophilous oak-beech forests, such as *Dermocybe cinnamomeolutea*, *Cantharellus tubaeformis*, *Lactarius camphoratus* and *Cantharellus cibarius* were less frequent. *Marasmius alliaceus* and *Mycena crocata* shoved the highest constancy on fallen beech twigs.

Mycological observations on permanent plots established in *Luzulo-Fagetum* patches in the Carpathian Mountains were carried out by Gumińska (1962b) in the Beskid Sądecki ridge. However, the development of fruit bodies of terrestrial fungi were the chief concern of this author, hence the table and list of species includes but few macromycetes fructifying on fallen leaves, twigs and wood (Table 4b, c. No. 38). Of the terrestrial fungi, she found most of the species recorded in *Luzulo-Fagetum* association in the Western Bieszczady Mts.

The same author presented the results of studies performed in the association *Dentario glandulosae-Fagetum* (= *Fagetum carpaticum*). In additio to the numerous group of macromycetes noted in various beech forest communities and related associations, she found several species mostly reported from mountain beech forests, e.g. *Cortinarius torvus*, *Mycena capillaris* and *Collybia fuscopurpurea*.

In the Beskid Sądecki ridge, in the Roztoka Mała valley, Gumińska (1962a) collected numerous macromycetes in the course of a single season in the Carpathian fertile beech forest. Half of these fungi were species common to the *Melico-Fagetum* association of north-western Poland, whereas the others were more frequently noted in mountains than in lowlands and they are rare in Poland. The same author also carried out mycological research in the Pieniny National Park (Gumińska 1969) and found 200 species of fungi, of which 92 were collected from beech and fir-beech forests probably belonging to the *Dentario glandulosae-Fagetum*. The comparison of the mycoflora of Pomeranian fertile beech forests with that of the beech forest in the Pieniny Mts. shows a high percentage of fungi in: common (68 per cent) and among them the following species characteristic of beech forests. *Clavariadelphus pistillaris, Boletus erythropus, Dasyscyphus virgineus, Marasmius alliaceus, Oudemansiella mucida* and others. Moreover, a number of rare species, not found in the beech forest studied in north-western Poland, were recorded here.

W o j e w o d a (1964, 1965) carried out sporadic mycological investigations in the Carpathian beech forest of the lower montane zone of the Gorce Mts. and on the Babia Góra Mt. and found fungi which were mostly common both in lowland and mountain beech forest.

Not only was the lower montane form of the *Dentario glandulosae-Fagetum* association investigated from the mycological standpoint. Recently, mycosociological studies were carried out in numerous patches of the submontane form of this association, formerly known as *Fagetum carpaticum collinum*. Studies over several years on plots established in patches of the submontane form were carried out by W o j e w o d a (1971) in the Ojców National Park. This beech forest occurs on brown soils and rendzinas (pH 6-7) on northern slopes. The vascular flora is similar to that of oak-hornbeam forests. W o j e w o d a recorded 245 species of macromycetes of (48 per cent on wood), about 1/5 of which were fungi growing exclusively in beech forest patches. Of the macromycetes found, many were observed in beech and oak-beech forests as well as in oak-hornbeam communities on the lowland. It is astonishing, that, despite numerous and frequent observations, no fruit bodies of *Marasmius alliaceus* and *Mycena crocata*, characteristic of beech forests, were observed on the beech forest plots in the Ojców National Park.

The submontane form of the Carpathian beech forest occurs also in the Świętokrzyskie Mts. Mycosociological studies in this area were carried out by the present author in the Łysogóra ridge. Here beech forests overgrow the lower parts of slopes with a loess substrate. The dominant beeches and firs, with a sycamore, lime and maple admixture form the tree layer here. Fungi fructifying on the ground as well as those on fallen leaves and other minute plant remnants were prevalent on the three permanent plots. Similarly as in the Ojców National Park, they belonged mostly to species recorded in various forest associations of the *Fagetalia* order. Several species, most frequently observed in mountain beech forests, such as *Porphyrellus pseudoscaber, Cortinarius nemorensis, Omphalina epichysium, Hericium coralloides* (Tables 4a, b, c, No. 30) were noticed in patches of the association discussed. D o m a ń s k i (1962) described a number of saprophytic fungal species of the order *Aphyllophorales* on rotten wood.

Detailed mycosociological studies were performed by S a ł a t a (1972) on nine, 400 sq m permanent plots of the submontane form of the *Den-*

tario glandulosae-Fagetum association in Central Roztocze. On the basis of separate analyses of fungi growing on beech wood in various stages of decomposition, of fungi occurring on leaves, fruits and excrements and again separately — of terrestrial fungi, this author arrived at the conclusion, that xylophilous fungi fructifying on plant and animal remains exhibit no dependence on the forest association, but are conditioned exclusively by the substrate, on which they occur. In view of this, probably these fungi cannot be considered as characteristic of forest associations even in the local sense. Only terrestrial fungi should be treated as components of the association, equivalent with vascular plants.

Long-standing studies on the contribution of macromycetes to various forest communities indicate, however, that, though xylophilous fungi seem to form their own associations on wood of definite tree species, they should not be excluded in the selection of characteristic and distinguishing species of the forest association. The tree species on which these fungi fructify is a constant component of the association and develops under the influence of the whole of ecological conditions occurring in the association, thus these fungi form associations dependent on the surrounding forest association. Comparative materials proved, that among these fungi several species characterizing the definite forest community may be selected. For instance, Sałata (1972) found several fungal species on beech branches and twigs, which were closely connected with the beech forest and can be treated as characteristic species. Here belong: *Mycena subalpina* (= *Hydropus subalpinus*) hitherto observed only in beech forests, generally near the northern limit of their distribution as well as *Mycena crocata* and *Marasmius alliaceus* found in both mountain and lowland beech forests. In beech forests of Roztocze these species show a high degree of constancy (Table 4c, No. 31). In the groups of fungi fructifying on the litter and on the ground, many species are common to the Pomeranian beech forest (Tables 4a, b. No. 31). Several species of the third and fourth degree of constancy belong to fungi characteristic of oak-hornbeam forests, e.g. *Amanita phalloides, Lepiota nuda* and *Clitocybe nebularis*. They confirm a closer relation between the submontane form of the Carpathian beech forest and the oak-hornbeam associations. Most of the other fungi belong to species generally found in mountain beech forests.

Wojewoda (1960) and Gumińska (1962b) carried out mycological studies in the Sudetian fertile beech forest association — *Dentario enneaphyllidis-Fagetum* but only on the area of the Cracow Jurassic upland near Rabsztyn. The results of mycological observations on five, 400 sq m plots were utilized as comparative material. These plots were established in beech forest patches overgrowing the rocky substrate consisting of Jurassic limestone. Owing to this, in addition to species typical of mountain beech forests, fungi recorded in the *Carici-Fagetum* association and in the orchid subassociation of *Melico-Fagetum*, e.g. *Russula aurata*, *Boletus luridus* and *Inocybe petiginosa* (Table 4a, No. 32) are noteworthy. Of species characteristic of beech forests, no fruit bodies of *Mycena croata* were found there, and no species distinguishing this association could be selected.

3. Fungi of beech forests of the south-western part of the *Fagus* zone in Europe

Smickaya (1955) studied the areas adjacent to the south-eastern frontier of Poland and took into consideration the fungi found in beech forests of the eastern Carpathians in the trans-Carpathian district of the Ukrainian S.S.R. Beside a number of parasitic fungal species occurring on leaves and twigs of trees and shrubs, this author mostly cites species common in the beech forests studied, e.g. *Strobilomyces floccopus*, *Russula cyanoxantha*, *Lactarius pallidus*, *L. subdulcis*. Wasilkov (1955) devoted a chapter of his work to a characteristic of the mycoflora of beech forests of western Ukraine and mentioned the following fungi connected with beech forests: *Lactarius blennius*, *L. pallidus*, *Oudemansiella longipes*, *O. radicata*, *Marasmius alliaceus* and *Coprinus picaceus*. The observations of these Russian mycologists confirm the mycological research made in Polish beech forests.

Ample comparative material is provided by Pilát's (1969) work, in which he analyzes the macromycete flora of various plant communities in Czechoslovakia. On the lowlands of this country, beech forests occupy a relatively small area, reduced by human activity. Well preserved patches of fir-beech forest occur mainly in valleys. According to Pilát, beech forest growing on calcareous soils possess a richer mycoflora than those on acid soils. Of fungi connected with beech forests and noted in the environ of Stribrne Skalici Pilát quotes from Pouzar the following species growing on wood of *Fagus*: *Oudemansiella mucida*, *Inonotus nodulosus*, *Polyporus varius var. nummularius*, *Plicatura faginea*, *Hericium coralloides*, *Marasmius alliaceus* and *Mycena crocata*. Moreover, *Boletus luridus*, *Phylloporus rhodoxanthus*, *Hygrophorus eburneus*, *Russula fellea*, *Lactarius blennius*, *L. glaucescens*, *L. pallidus*, *Cortinarius torvus*, *Craterellus cornucopioides* and other species fructified on the ground in the environs of Prague. Most of them, with the exception of mountain species, were observed in the Pomeranian beech forests studied.

The best preserved mountain beech and fir-beech forests in Czechoslovakia occur in the Carpathian Mountains. The differences in mycoflora between pure beech forests and beech forests with fir (*Abies alba*) are wider than those in the composition of vascular plants. According to Pilát, only few fungal species are closely connected with fir. Most of fungi accompanying fir may grow also on wood of other coniferous trees, particularly of spruce. More fungal species are connected with beech. Moreover, mountain beech forests, particularly those of primeval character, possess a relatively small number of terrestrial fungi as compared with xylophilous species. Of terrestrial fungi from fir-beech forest Pilát reports: *Boletus erythropus*, *Russula cyanoxantha*, *R. vesca*, *R. fellea*, *Lactarius blennius*, *Tricholoma columbetta* and *T. virgatum* var. *sciodes*, and of fungi from the litter — *Mycena crocata*, *Mycena pelianthina* and *M. pseudopura*. With the exception of both the species of the genus *Tricholoma* and *Mycena pseudopura*, all the fungi mentioned by Pilát were also found in the Pomeranian beech forests. According to Pilát, *Marasmius alliaceus* is one of the most characteristic species of mountain beech forests. *Pleurotus petaloides*, *P. lignatilis* and *Hericium coralloides* occur on the beech stumps. On dead, but still standing beech trunks *Oudemansiella mucida* occurs while at the trunk bases — *Grifola umbellata* can be observed. Fungi of the family *Polyporaceae* sensu lato constitute a large group. Among them, *Pycnoporus cinnabarinus*, generally growing on beech branches, is a very characteristic species.

In Czechoslovakia the well known natural fir-beech forest (*Abieti-Fagetum*) with a spruce admixture in the reservation „Boubinsky prales" in the Šumava ridge should be mentioned. Kubička (1960) found here a great number of interesting, mainly mountain fungal species, such as: *Porphyrellus pseudoscaber*, *Fomes roseus*, *Trametes hoehnelii*, *Hydropus marginellus* and *Omphalina epichysium*. The macromycete flora of this community exhibits but few features in common with beech forests of north-western Poland — only 26 per cent of the species occur in both regions. This low percentage is due, in the first place, to the high contribution of fungal species connected with wood of coniferous trees, particularly of spruce and fir.

We next consider the mycosociological work, carried out by Leischner-Siska (1939) in the *Fagetum praealpinum* association in the environ of Salzburg. This association has the character of a mixed forest, in which *Fagus sylvatica* predominates, whereas *Abies alba*, *Ulmus scabra*, *Quercus robur*, *Acer pseudoplatanus*, *Padus avium* and *Picea excelsa* constitute an admixture. Studies were performed on 100-m² plots. A total number of 150 macromycete species were found on 11 plots. Of these species 63 (42 per cent) were common to the *Melico-Fagetum* association in north-western Poland. The fungi with a wider ecological range, such as: *Oudemansiella radicata*, *Lactarius piperatus*, *Hygro-*

phorus eburneus and others, had the highest constancy (degree V) in *Fagetum praealpinum*.

The mycoflora of the *Abieti-Fagetum noricum* in the environ of Sopron in Hungary exhibits a similar character. Owing to the influence of the subalpine and mountain climate as well as to the higher contribution of various tree species (*Picea excelsa*, *Quercus petraea*, *Carpinus betulus*) the mycoflora of this area is particularly rich (Ubrizsy 1966). About 58 per cent of species observed here are common to the mycoflora of the *Melico-Fagetum* in Pomerania.

Far less species common to the Pomeranian fertile beech forest (34 per cent) are found in acidophilous beech forests belonging to the *Luzulo-Fagetum subcarpaticum* association, which occurs mainly in the Zemplen and Bükk mountains in north Hungary. The composition of the mycoflora here resembles rather that of the Carpathian acidophilous beech forest (Bohus and Babos 1967, 1969).

From the areas nearest to the southern limit of the beech zone in Europe we consider mycological work undertaken in beech forests of Yugoslavia. The beech forest communities belonging to the south European aliance *Fagion illyricum* Horv. 1938 is wide spread in the mountainous regions of this country. *Fagus sylvatica* is replaced in the tree stand by *Fagus moesiaca*, while *Abies alba*, *Acer platanoides*, *Tilia argentea*, *Ilex aquifolium* and *Picea excelsa* exhibit a higher or lower contribution here. At lower altitudes the mountain beech forest — *Fagetum montanum* with a hornbeam and oak admixture occurs, in the higher mountain zone the *Abieti-Fagetum* association dominates and directly above it the *Fagetum subalpinum* association develops, sometimes with a considerable contribution of spruce. In dependence on the geographical situation Horvat (1963) distinguished the following associations: *Anemone-Fagetum* in Slovenia, *Fagetum croaticum* in Croatia and Bosna, *Fagetum moesiacae serbicum* in Serbia, *Fagetum montenegricum* in Montenegro and *Fagetum macedonicum* in Macedonia.

Mycological studies in beech and fir-beech forest associations were carried out mainly in Croatia (Tortić 1966, 1968, 1970), Serbia (Jelić 1966, 1967; Čolić 1968; Lisiewska, Jelić 1971) and recently in Bosna (Tortić, Lisiewska 1972). The comparison of the macromycete flora of the fertile lowland beech forest in the north-western regions of Poland with that of Yugoslavian beech forests demonstrates the different percentage (37-64 per cent) of fungal species common to both these areas (Table 5). The fir-beech forest communities of the Tara mountain in Serbia have the lowest number of fungal species in common with Polish beech forests (Čolić 1968). The spruce plays an important role here introducing a number of accompanying fungi. The Yugoslavian beech forests are mostly of a natural, primeval character and are not influenced by human activity to such a degree as in Poland. They are particularly rich in rotting wood, constituting the substrate for many fungal species. Owing to this, the floristic lists exhibit a considerable percentage of xylophilous fungal species. Among them, *Stereum insignitum* Quél. is particularly noticeable. It occurs in large quantities on fallen branches and wood of *Fagus* in almost all the beech forests studied in Yugoslavia. This interesting, Mediterranean and Submediterranean-Atlantic species, which is known up to now only from the southern half of Europe (Tortić, Jelić 1972) may be accepted as characteristic of beech forests belonging to the *Fagion illyricum* alliance (Lisiewska, Jelić 1971). *Auricularia mesenterica* was also common on beech wood in Yugoslavia. The well known oak parasite *Inonotus dryadeus*, usually forming fruit bodies at the base of oak trunks, was observed in fir-beech forests of Yugoslavia on several sites at the bases of fir trunks (Torić, Lisiewska 1972). Of the group of terrestrial fungi, *Lactarius glaucescens* Crossl. is noteworthy. It fructified, on some sites in abundance, in the *Fagetum montanum* and *Luzulo-Fagetum* associations in Serbia and Bosna. This species may be easily mistaken for *Lactarius piperatus*, which is common in beech forests. *Lactarius glaucescens*, regarded as rare, was reported from beech forests in Czechoslovakia as well as from oak-hornbeam and even coniferous forests in various parts of Europe (Neuhoff 1956). The fir-beech forests of Serbia are characterized by the two fungal species: *Sarcosphaera eximia* and *Geastrum triplex* but these are rarely found in the Carpathian beech forest on a similar, calcareous substrate (Table 4a: Nos. 34, 35).

The macromycete flora of Yugoslavian beech forests has a contribution of mountain species, frequently recorded in Carpathian beech forests, as well as species closely related with *Abies*, such as *Bondarzewia montana* — a rare fungus reported from several sites in the *Abieti-Fagetum* association (Tortić, Jelić 1969). *Marasmius alliaceus*, characteristic of beech forests, was noted in all the beech and fir-beech forests studied in Yugoslavia, whereas *Mycena crocata* was found far less frequently.

One further beech community, namely the acidophilous *Musco-Fagetum* (= *Fagetum muscetum*) association, should be mentioned for compartive purposes. It occurs on steep, south-eastern slopes exposed to the strong wind erosion, for instance in the Fruška Gora massif north-west from Belgrade. The beech forms outlying islands here, separated from its main distributional area (Fig. 2). The trees are stunted and deformed. The very poor field layer consists of acidophilous species, and mosses and lichens play the most important role on the forest floor. The mycoflora of this community differs widely from the other described beech associations of Yugoslavia. The following fungal species are the most interesting ones found in the *Musco-Fagetum* association: *Astraeus hygrometricus* — a xerothermic Pontic-Pannonian species and *Pulveroboletus cramaesinus*. These species were not recorded in the compared European beech forest communities. Moreover, fungi observed in acidophilous oak-beech forests near the northern limit of the beech range, such as: *Russula vesca*, *Cantharellus cibarius* and *Boletus erythropus* also fructified here (Table 4a: No. 40).

The mycological works discussed above do not cover all the beech forest communities within the distributional area of the beech. This is because the present author was unable to consider comparable works from the western part of the beech area in Europe, e.g. from England, France, Switzerland or Italy. Despite this, however, the available data give a certain picture of the mycoflora of the various beech forest associations of central Europe.

FUNGI OF BEECH FORESTS AGAINST THE BACKGROUND OF RELATED FOREST ASSOCIATIONS

Most fungal species occurring in beech forest associations are not exclusively confined to a single forest community. Analyses of the macromycete flora of the beech forests investigated demonstrate, beside ubiquitous species, a relatively numerous group of fungi, which find suitable developmental conditions also in plant communities allied to beech forests.

The contribution of the most important fungi of beech forests to various forest communities belonging mainly to the *Fagetalia* order is illustrated in Table 4. This Table indicates also the distinguishing value of these species. Only species of a very wide ecological range have been omitted in the Table 4.

1. Alder and ash-elm forests

Ash-elm forests are the most hygrophilous and eutrophic forest communities of the order *Fagetalia*. The Beech Forest near Szczecin was taken for comparative investigation, since patches of alder and ash-elm forest occur here in the neighbourhood of the beech forest associations studied (*Melico-Fagetum* and *Mercuriali-Fagetum*).

Patches of alder forest (*Carici elongatae-Alnetum*) develop in small depressions in the area, on intensively inundated soils of the bog type. The tree-stand consists of black alders growing on characteristic islets overgrown with a moss carpet. No shrub layer occurs. The field layer consists of *Cardamine amara*, *Carex elongata* and other bog plant species.

Similar habitat conditions exist in the *Circaeo-Alnetum* association, in which black alders occur, while *Cardamine amara*, *Chrysosplenium alternifolium*, *Circaea lutetiana* and *C. alpina* prevail in the field layer.

Less humid soils of the black earth type are occupied by *Carici remotae-Fraxinetum*. Ash predominates in the tree-stand, while alder, elm and beech constitute an admixture. The field layer is characterized by *Carex remota*, *C. strigosa*, *Veronica montana*, *Rumex sanguineus* and *Circaea intermedia* (Celiński 1962).

In the alder and ash-elm forests of this area Bujakiewicz (1969) carried out studies on 7 permanent plots (100 m^2) and found 100 macromycete species, a certain percentage of which represented species found in beech forest associations.

In the synusia of terrestrial fungi, most species in common with alder and ash-elm forests (Table 4a: Nos. 1-3) were observed in the *Merculiali-Fagetum* association. Doubtless, this is due to the similar habitat conditions occurring in the compared associations. The patches of *Carici elongatae-Alnetum* inundated for the longest period during each season produced fewest terrestrial fungi (Bujakiewicz 1969). A number of bryophilous fungal species, such as *Galerina hypnorum*, *Gerronema fibula* and *G. setipes*, occurring most frequently on the ground in patches of mossy acidophilous oak-beech forests, were observed mainly on rotten alder stumps overgrown with mosses in alder and alder-ash--elm forests. Most terrestrial fungal species observed in the *Mercuriali--Fagetum* association were found on fertile, humid soils in patches of the *Carici rematae-Fraxinetum*, e.g. *Naucoria subconspersa*, *N. scolecina*, *Laccaria tortilis* and *Pholiotina mairei*. These are mostly fungi developing small fruit bodies. Some of them form mycorrhizae with the alder. The contribution of terrestrial fungi frequent in the Pomeranian *Melico--Fagetum* association was very low in the alder and ash-elm forest. Single fruit bodies of *Hygrophorus eburneus* and *Russula mairei* were found only on the margin of alder and ash-elm forests adjacent to the patches of *Melico-Fagetum*.

The number of fungi of beech forests fructifying on plant remnants was still lower. *Dasyscyphus virgineus*, *Xylosphaera carpophila*, *Mycena capillaris* and others were only sporadically found in the alder and ash-elm forests and they fructified on beech leaves and fruits blown by the wind.

On the other hand, some of xylophilous fungal species common in beech forests and developing not only on beech wood, but also on wood of other deciduos trees, were more frequent, e.g.: *Pluteus cervinus*, *Mycena vitilis*, *M. haematopoda*, *Marasmius rotula*, *Tremella mesenterica* and *Coryne sarcoides*.

The xylophilous fungal species penetrating into the alder and ash--elm forests in the Beech Forest near Szczecin, were recorded also in

Fraxino-Ulmetum in the western part of Poznań Province (Bujakiewicz 1964) in patches with no beech admixture as well as in *Alnetum glutinosae* and *Circaeo-Alnetum* in the Białowieża National Park beyond the *Fagus* range (Nespiak 1959).

2. Oak-hornbeam forests

Mesophilous decidous forests, formerly classified to the *Querco-Carpinetum* association occur in lowlands and on the submontane zone on soils of the brown earth type. The following two regional associations were distinguished within this association in Poland: *Galio (silvatici)-Carpinetum* and *Tilio-Carpinetum*. The first is an oak-hornbeam community of a central-European character and occurs in western and south-western Poland. The second association has a subcontinental character (Matuszkiewicz 1967) and occupies the remaining areas of this country.

As regards the edaphic conditions, the oak-hornbeam communities closely resemble the beech communities. Both oak-hornbeam and beech forests may grow on alkaline soils rich in calcium carbonate (rendzinas) as well as on acid, impoverished, weakly podsolised soils. Both these communities avoid extremely humid ground, but in conditions of dry climate oak-hornbeam forests develop better than beech. Floristically they differ by the presence of their own characteristic species, frequently of a regional character (for oak-hornbeam forests — *Carpinus betulus* and *Stellaria holostea*). Species of the order *Fagetalia* and class *Querco-Fagetea* constitute a large group in phytosociological list of vascular plants. The tree stand consists of hornbeams and pedunculate oaks as constant components, and sometimes exhibits a beech admixture.

The floristic and habitat conditions described are reflected in the mycoflora of this community. Several years' study of the macromycetes of the *Galio-Carpinetum* association in Paznań Province (Lisiewska 1965) proved, that many of the fungel species were also common in beech forests but were absent in the most fertile ash-elm association. This indicates a close relation between oak-hornbeam and beech forests.

A comparison of the contribution of beech forest fungi to the *Galio-Carpinetum* association in Poznań Province (western Poland) with that to the *Tilio-Carpinetum* in Łódź Province (central Poland) elaborated from the mycosociological standpoint by Ławrynowicz (1973), exhibits no essential differences between these associations. Only the patches of oak-hornbeam forest with a beech admixture are distinctive. Mycosociological studies performed in *Galio-Carpinetum stachyetosum* with *Fagus* admixture proved, that beech considerably influences the composition of the mycoflora of the community in which it occurs. This influence concerns not only fungi developing on fallen leaves, fruits and wood, but also certain terrestrial fungi, particularly those forming mycorrhizae with this tree. The following species occurring in patches of oak-hornbeam forest with beech may serve as an example: terrestrial fungi — *Lactarius pallidus, Lactarius blennius, Russula mairei, Hygrophorus eburneus* and *Coprinus picaceus;* fungi on fallen leaves and fruits — *Dasyscyphus virgineus, Xylosphaera carpophila, Phaeomarasmius carpophilus, Mycena pelianthina* and *Clitocybe fragrans;* xylophilous fungi — *Oudemansiella mucida, O. radicata* and *Collybia fusipes.* On the other hand, fruit bodies of such fungi as *Marasmius alliaceus, Mycena crocata* and *Hydropus subalpinus,* characteristic of beech forests, were not found on dead beech twigs in these patches, despite very frequent observation over several years.

A large group of fungi, similarly frequent in both the beech and oak-hornbeam forests, was recorded in *Galio-Carpinetum* and in *Tilio-Carpinetum* associations without *Fagus* (Tables 4a, b, c: Nos. 4-11). In this case, it is not so much the tree species, as the entire edaphic and microclimatic conditions occurring in forest associations that influence the specific composition and quantitative ratios of the macromycete flora. Mycorrhizal and xylophilous fungi belonging to this group accompany not only the beech, but also other deciduous tree species.

There exists an interesting, though small, group of terrestrial fungi, which find most favourable developmental conditions in various oak-hornbeam communities. Here belong: *Amanita phalloides, Lepista nuda, Clitocybe nebularis* and *Russula virescens.* They probably form mycorrhizae with the oak and also, to a lesser degree, with the beech. Thus, though they predominate in oak-hornbeam woods, they may be found also in the fertile lowland and mountain beech forests.

3. Pine-oak forests

Acidophilous mixed coniferous forests, classified to the association *Pino-Quercetum* Kozłowska 1925 emend. Mat. et Polak. 1955, belong to forest communities widely distributed on lowland areas of Poland. They occupy also a vast area of Western Pomerania. Since the acidophilous beech and beech-oak forests studied from the mycological standpoint are frequently situated in the neighbourhood of patches of mixed coniferous forest, the contribution of beech forest fungi was examined in this forest community.

The Wolin Island National Park, in which mixed coniferous forest occupy the largest area, was selected as the comparative area. The *Pino-Quercetum* association occurs on a flat or slightly undulating area in the diluvial part of the Island. It grows on sandy, often weakly podsolised, acid soils (pH 4.0). The shallow accumulation-humus horizon lies beneath a relatively thick layer of raw humus. Pines are generally dominant in the tree stand, whereas on some sites beeches and pedunculate oaks constitute a considerable admixture. The shrub layer consists of seedlings of the same trees. *Vaccinium myrtillus* or *V. vitis-idaea* with a lesser contribution of *Melampyrum pratense, Trientalis europaea, Deschampsia flexuosa, Calluna vulgaris* and other components of fresh coniferous forests predominate in the well developed field layer. The moss layer is also well developed and compact (Piotrowska 1966, Piotrowska, Żukowski 1967).

Mycosociological studies of 11 permanent plots in the Wolin Island National Park (Lisiewska 1966a), indicated, that, as with the acidophilous beech-oak forests, this association belongs to the richest, as regards the number of fungal species. Only the plot established in the more open pine-oak forest exhibited a poorer flora of macromycetes.

A considerable group of terrestrial fungi in common with acidophilous beech-oak and beech forests is distinctive in the mycoflora of mixed coniferous forest patches (Table 4a, No. 26). Here belong: *Gerronema fibula, Galerina hypnorum, G. mniophila* — species growing among mosses as well as *Cystoderma amiantinum, Dermocybe cinnamomeolutea, D. semisanguinea, Cortinarius collinitus* and other species of poor habitats. Doubtless, this is due to the situation of the investigated area, i.e. the furthest north-western part of Poland, on which the contribution of forest communities typical for West Europe is visible.

The character of the mycoflora of *Pino-Quercetum* patches is but slightly influenced by the presence of beeches. This influence is more visible in the group of xylophilous than terrestrial fungi. None of the fungal species characterizing fertile lowland and mountain beech forests were found here. The few species common in beech forests, such as *Lactarius blennius, Russula mairei, R. cyanoxantha, Mycena vitilis* or *Collybia peronata* belong to fungi of a wider ecological range. The remaining macromycetes are components of coniferous trees, generally associated with the pine.

Similarly as on Wolin Island, mixed coniferous forests (*Pino-Quercetum serratuletosum* Mat. 1955) of the Białowieża National Park are characterized by the highest number of macromycete species, as compared with other forest communities of this area (Nespiak 1959). The beech is absent in the tree stand of the Białowieża coniferous forests and is replaced by spruce. The contribution of deciduous trees, such as hornbeam, maple and lime is higher here. The macromycete flora exhibits a low percentage of fungi known from fertile lowland beech forests, but frequently penetrating into related forest communities, acidophilous mixed forests inclusively. Here belong *Lactarius subdulcis*, *L. vellereus*, *Craterellus cornucopioides*, *Russula lepida*, *R. alutacea*, *R. felea* and *Mycena palianthina*.

4. *Abies alba* forests

Patches of mesotrophic fir forests with a preponderance of vegetation of deciduous forests as well as patches of more acidophilous fir forests occur on the mountain and upland south-eastern areas of Poland. Matuszkiewicz (1967) classified the first of these fir communities, known as *Abietetum* and occurring in the lower montane zone and in the submontane zone of the Carpathians, to the *Fagion silvaticae* alliance. The second community, connected with the acid substrate of the Świętokrzyskie Mts. and the Roztocze Ridge and known as *Abietetum polonicum*, has been partly included in the *Vaccinio-Piceion* alliance. In view of the lack of a complete phytosociological description of these associations, the forest patches with *Abies alba*, compared from the mycological standpoint, are referred to in general as "fir communities".

In Poland, mycosociological studies in fir communities were carried out by Gumińska (1966) in the environs of Muszyna, by Sałata (1972) in the central part of Roztocze and by the present author in the Świętokrzyski National Park.

In all the patches studied by these authors the tree layer consists of the dominant fir with an admixture of beech, spruce and occasionally pine. The shrub layer is formed mainly by beech-fir-spruce undergrowth and in some places rowan, hornbeam and alder buckthorn may occur. Acidophilous species of coniferous forests and species belonging to the class *Querco-Fagetea* greatly contribute to the field layer. In some localities (e.g. Roztocze) a well developed moss layer may be observed.

Fungi fruiting on the ground and in the litter constitute the most numerous group in fir communities of Central Roztocze. A comparison of the number of macromycete species found by Sałata (1972) in fir and beech forests of this area showed that plots with prevailing fir were richer in this respect, moreover almost half of the macromycetes observed were common to both these communities. Fungal species reported various coniferous forest communities prevailed in the *Abietetum polonicum* patches. In addition, fungi occurring also in decidous forests, among them species found in acidophilous beech-oak, beech or oak-hornbeam forests, constituted a considerable group (Table 4a, No. 41). The contribution of terrestrial fungi of fertile beech forests was very low in the fir communities of the Roztocze Ridge. Only *Tricholoma pardinum*, *Russula olivacea*, *Strobilomyces floccopus*, *Boletus erythropus*, *Porphy-*

rellus pseudoscaber and *Hygrophorus pudorinus* were sporadically noticed in fir forest patches. It should be mentioned, however, that the two latter species are characteristic of mountain beech forests, in which fir is a constant component. Of fungal species developing on fallen leaves and fruits *Marasmius bulliardi* fructified on both beech leaves and fir needles. Other species frequent in beech forests, such as *Dasyscyphus virgineus*, *Xylosphaera carpophila*, *Mycena pelianthina*, *M. stylobates*, *Collybia butyracea* var. *asema* and *C. peronata* were found exclusively on beech fruits and leaves. Of xylophilous fungi *Marasmius alliaceus* and *Mycena crocata* occurred sporadically on beech twigs in some fir forest patches.

The contribution of beech forest fungal species to the mycoflora of the fir forest in the Świętokrzyski National Park was far lower than that in Roztocze (Tables 4a, b, c, No. 42). The tree stand shows a distinctly primeval character here. On many sites the standing trunks of dead firs provide a perfect substrate for fungi of the family *Polyporaceae*. On the other hand, rotten beech wood is far less frequent and only several macromycete species of wide ecological range were found on it. The contribution of beech forest fungi developing on the ground and on minute plant remnants was also slight. Analogously as in the fir communities of Roztocze, species connected closer with acidophilous mixed forests and other deciduous forest communities, mainly oak-hornbeam forest, prevailed in the Świętokrzyski National Park.

In fir forests of the northern part of the Dubne Range near Muszyna, vascular plants belonging to the class *Querco-Fagetea* prevailed in the field layer. On 13 permanent 100-m² plots G u m i ń s k a (1966) observed fruit bodies of 127 macromycete species, 64 of which were common to mountain beech forests of the environs of Rabsztyn and Maciejowa. Beside fungi most frequently met in mountain fir-beech forests (*Porphyrellus pseudoscaber*, *Hygrophorus pudorinus*) and other species connected with fir, the fir forests near Muszyna showed the presence of fungi known from lowland beech forests, such as *Boletus erythropus*, *B. calopus*, *Craterellus cornucopioides*, *Lactarius pallidus*, *Collybia peronata*, *Oudemansiella platyphylla*, *Ganoderma applanatum* and other species noted in allied beech forest communities of the order *Fagetalia* (Tables 4a, b, c, No. 43). The species characteristic of beech forests, *Marasmius alliaceus* and *Mycena crocata* were not found here.

The comparison of fungal flora of beech forests with the mycoflora of allied forest communities in various habitats indicated the existence of many species from which one could select macromycetes, which characterize the beech forest communities studied.

SUMMARY OF RESULTS AND CONCLUSIONS

1. The principle aim of this work was to summarize the longstanding studies on the participation of macromycetes in different beech forest communities and to establish the diagnostic role of this group of cryptogams in phytosociological researches.

2. Mycological observations were performed on 400-m^2 permanent plots. This surface area proved optimum for such investigations in floristically varied forest associations such as beech forests and other allied plant communities. The sum of all the observations of fungi on the given area in the course of 2-3 vegetation seasons should be accepted as mycosociological record.

Synthetic tables (Tables 1-3) were elaborated on the basis of the data obtained concerning the abundance (Moser's 1949 scale) of fructifying fungal species and the character of substrate. These tables comprise all the macromycetes of the beech forest communities in north--western Poland (330 species, 3 varieties and 5 forms).

3. The following conclusions can be advanced on the basis of a number of author's considerations on the role of macromycetes in the phytocenose structure as well as on that of the author's own observations on the contribution of macromycetes to various forest associations:

a) Mycorrhizal macromycetes and saprophytes fructifying on the soil show the closest relation to definite vascular plant communities. They form synusiae i.e. a structurally — functional element of the given phytocoenose. Most indicator species, characterizing not only the forest association, but also distinguishing lower phytosociological units (subassociations, facies) in dependence on the habitat conditions and floristic composition particularly that of trees, occur among terrestrial fungi.

b) Macromycetes developing mostly small fruit bodies on fallen leaves, fruits and other plant and animal remnants are somewhat closer connected with the substratum, on which they grow. More frequently than terrestrial fungi, they are found in allied communities, if they encounter a suitable substratum here. Nevertheless, this ecological group of macromycetes also seems to form synusiae, since most favourable developmental conditions occur in one or, eventually, several communities belonging to a single alliance. In view of this, fungi developing on fallen, not yet decomposed, leaves and fruits may characterize a group of associations of the given alliance.

c) Xylophilous fungi seem to be most closely connected with the substrate on which they grow. On the other hand, not all the species of this group are equally conditioned by their substratum. There is no distinct limit between the synusia of fungi developing on fallen leaves and fruits and the group of fungi fructifying on fallen beech twigs and branches buried in the litter. Among the latter fungi several species may be distinguished, some of which well characterize lowland and mountain beech forests, whereas others prefer either fertile lowland or fertile mountain beech forests. They do not penetrate into allied communities despite the occurrence of suitable substratum.

Macromycetes developing fruit bodies on rotting stumps and logs should be treated differently. These fungi react to the degree of wood decay. Different species fructify on fresh wood of fallen or felled tress, others on partly rotten timber and still other fungi develop on very rotten, decomposing stumps and logs. This ecological group of fungi developing on rotting wood may be assumed as a component of a dependent association together with other cryptogams (mosses, lichens, myxomycetes), whereas the changes occurring in the specific composition in parallel with the proceeding decomposition of wood may be interpreted as successive phases of the same association, e.g. initial, optimal, terminal phase (K r e i s e l 1961).

Analogously, parasitic and saprophytic fungi on trunks and roots of living beeches form dependent associations with a somewhat distinctive character. On the other hand, these associations are influenced by phytoclimatic conditions existing in a definite forest community. Studies performed in various beech forest communities in central Europe proved, that many fungal species being components of dependent associations of cryptogams, developing on beech wood, are more closely related to the beech forest association than to allied forest communities.

4. Taking into consideration the existing classification into three main groups according to their micro-habitats, the author has investigated the contribution of macromycetes to particular beech forest communities in north-western Poland and compared the results obtained with those of mycological studies in mountain beech forests of south-eastern Poland and of other European countries within the beech distributional area (Tables 4a, b, c).

5. Mycological observations performed in the subassociation *Melico-Fagetum cephalantheretosum rubrae* proved, that fungi also confirm the specifity of this community in respect to other subassociations of fertile lowland beech forest. Perhaps the mycoflora could be an argument for the classification of this interesting community to the *Cephalanthero-Fagion* suballiance as suggested by M a t u s z k i e w i c z (1958). The contribution of fungi to other associations belonging to this suballiance, however, should be examined. On the other hand, even now it can be established, that the subassociation discussed exhibits but few macromycete species common with the humid *Mercuriali-Fagetum* association.

6. In view of the, hitherto, varying opinions of phytosociologists in

respect to their systematic affiliation, the acidophilous beech forests and beech-oak forest are summarized together and only the grassy from with predominating vascular plants (mainly grasses) and the mossy one were distinguished.

In common with vascular plants the macromycetes confirm the intermediate position of the community referred to by phytosociologists as *Fago-Quercetum* between *Melico-Fagetum* and *Pino-Quercetum*.

Acidophilous beech forest patches with a well developed mossy layer and deficient herb layer in W-Pomerania (7 plots), Wesergebirge (German Federal Republic) and Fyn Island (Denmark) possessed a specific macromycete flora. Bryophilous and acidophilous fungi played the main role here. The distinct difference between these patches and the grassy form classified to *Fago-Quercetum typicum* confirms the supposition of Piotrowska and Żukowski (1967), that the mossy community, rather often observed within the Pomerania moraine ridges, merits the rank of an individual association.

7. A comparison of the mycoflora of Polish beech forests with that of central and south Europe indicates their considerable similarity. Polish mountain beech forests possess more species in common with fir--beech forests of Czechoslovakia, Hungary and Yugoslavia than the Polish lowland beech forests lacking firs and spruces. The number of macromycetes in common with the fertile lowland beech forest oscillated within the limits of 26-64 per cent (Table 5).

8. Analysis of the macromycete flora of the beech forests studied in comparison with the mycoflora allied forest associations point to the relatively wide ecological range of fungi occurring in these forests. Many of the terrestrial fungi found in the hygrophilous and eutrophic *Mercuriali-Fagetum* association were reported from alder and ash-elm forest associations as well. Patches of the fertile typical subassociation of *Melico-Fagetum* and the submountane form of *Dentario glandulosae--Fagetum* had a number of species in common with the oak-hornbeam association. Acidophilous beech and beech-oak forests were similar in respect of the mycoflora to pine-oak and fir forests, whereas mountain beech forests — to fir forests (Table 4a).

There exists a large group of fungi growing most frequently in various beech forest communities, but found also in allied forest associations both with and without *Fagus* admixture. Here belong: *Lactarius piperatus*, *L. subdulcis*, *L. vellereus*, *Russula lepida*, *R. alutacea*, *R. fellea*, *R. cyanoxantha*, *R. nigricans*, *Phallus impudicus*, *Craterellus cornucopioides*, *Tricholoma sulphureum*, *Clitocybe fragrans*, *C. hydrogramma*, *C. odora*, *Collybia peronata*, *C. butyracea* var. *asema*, *Mycena stylobates*, *M. filopes*, *M. vitilis*, *M. galericulata*, *Marasmius rotula*, *M. bulliardii*, *Polyporus varius* var. *nummularius*, *Tremella mesenterica*, *Kuehnero-*

Table 5

Contribution of macromycetes from the Melico-Fagetum association of North-Western Poland to different beech forest communities in Europe

Author		Lisiewska /1971/	Lange, Lisiewska /1969/	Kreisel /1957b/	Jahn, Nespiak, Tüxen /1967/	Gumińska /1969/	Jelić /1967/	Kreisel /1957a/	Ubrizsy /1966/	Gumińska /1962a/	Tortić /1966/	Leischner Siska /1939/	Čolić /1968/	Bohus, Babos /1967/	Kubicka /1960/
Locality		N-W Poland	Denmark Fyn	Germany Rügen G.D.R.	Germany Wesergeb. G.F.R.	Poland Pieniny	Yugosl. Goč	Germany Darss G.D.R.	Hungary Sopron	Poland Beskid Sądecki	Yugosl. Gorski Kotar	Austria Salzburg	Yugosl. Tara	Hungary Bükk	Czechosl. Sumava
Forest community		Melico-Fagetum	Melico-Fagetum	Beech forest	Melico-Fagetum	Dent.gl-Fagetum	Abieto-Fag.	Fago-Querc.	Abieti-Fag.	Dent.gl-Fag.	Fagetum abiet.	Fagetum praealp.	Piceeto-Abieto-Fagetum	Acidophilous beech forests	Abieto-Fagetum
Total number of species		261	130	106	77	92	91	89	46	91	73	130	228	100	200
Common species with M.-F. of N-W Poland	number	261	99	76	54	63	59	55	27	50	39	63	85	34	52
	%	100	76	71	70	68	64	61	58	55	53	42	37	34	26

myces mutabilis, *Oudemansiella platyphylla* and *O. radicata*. These species may be assumed as characteristic of the *Fagetalia* order.

9. Comparative research in allied forest associations with beech contribution (*Galio-Carpinetum* and *Abietetum polonicum*) proved, that the beech considerably influences the character of the mycoflora of the community, in which it occurs, introducing a number of accompanying fungi. The influence of the beech is visible in the synusia of terrestrial fungi (*Lactarius blennius*, *L. pallidus*, *Russula mairei*, *Hygrophorus eburneus*, *Coprinus picaceus*) as well as in fungi fructifying on fallen beech fruits and leaves (*Dasyscyphus virgineus*, *Phaeomarasmius carpophilus*, *Xylosphaera carpophila*, etc.) and especially in the populations of xylophilous fungi (Table 4c).

10. The author's own observations carried out in various beech forest communities in Poland as well as comparative data from a number of European countries proved, that the following macromycetes may be assumed to be characteristic for the beech forests of the *Fagion silvaticae* alliance Tx. et. Diem. 1936.

a) Terrestrial fungi prefering:

xerophilous beech forests on alkaline substratum — *Tricholoma pardinum*, *Russula maculata*, *R. olivacea*, *Boletus satanas*, *B. luridus*, *Cortinarius largus*, *Inocybe petiginosa*.

fertile beech forests on slightly acid substratum — *Helvella crispa*, *Boletus erythropus*, *B. appendiculatus*, *Strobilomyces floccopus*, *Stropharia squamosa*, *Russula solaris*, *R. grisea* var. *xanthochlora*, *Tricholoma ustale*.

fertile mountain beech forests — *Porphyrellus pseudoscaber*, *Cortinarius nemorensis*, *C. torvus*, *Hygrophorus pudorinus*, *Phylloporus rhodoxanthus*.

b) Fungi on fallen beech leaves and fruits prefering:

lowland beech forests — *Marasmius splachnoides*, *M. recubans*, *Tubaria pellucida*;

mountain beech forests — *Mycena fagetorum*, *M. capillaris*, *Collybia fuscopurpurea*, *Marasmius prasiosmus*.

c) Fungi on fallen beech twigs and wood prefering:

fertile lowland beech forests — *Hydropus subalpinus*, *Polyporus forquignoni*;

fertile mountain beech forests — *Hericium coralloides*, *Omphalina epichysium*, *Inonotus radiatus* var. *nodulosus*;

characteristic for lowland and mountain beech forests — *Marasmius alliaceus*, *Mycena crocata*, *Pycnoporus cinnabarinus*, *Oudemansiella mucida*.

Data concerning the geographical distribution of macromycetes in Europe (Hansen, Lange 1966; Skirgiełło 1965, 1970) confirm in the first place the occurrence of *Marasmius alliaceus* and *Mycena crocata* within the beech distributional area. These species were not found up to now only in the *Carici-Fagetum* association in Wesergebirge and in the beech forests of the Ojców National Park in southern Poland. Maybe, they avoid substratum too rich in calcium as it is supposed by Nespiak (1968b).

In the case of macromycetes, however, we cannot claim with full certainty, that a given species does not occur in the definite association, since we observe only fruit bodies, whereas the mycelium may exist in the substratum ready to fruit in subsequent years. In view of this, a more complete picture of the mycoflora of particular forest association can only be obtained from continuation of long-standing, mycosociological studies.

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Grzyby wyższe lasów bukowych we wschodniej części zasięgu buka w Europie

Streszczenie

Praca zawiera podsumowanie wieloletnich badań własnych i obcych nad udziałem grzybów wyższych w zbiorowiskach leśnych, których głównym komponentem jest buk. Prześledzono jaki jest stosunek tej grupy roślin zarodnikowych, rozwijających się w różnorodnych siedliskach i na różnym podłożu, do całości fitocenozy oraz podjęto próbę określenia roli diagnostycznej, jaką mogą odgrywać grzyby w badaniach fitosocjologicznych.

Badania mikosocjologiczne prowadzono przede wszystkim na obszarze północno-zachodniej Polski w zbiorowiskach żyznych i acidofilnych buczyn niżowych. Dla otrzymania pełniejszego obrazu mikoflory lasów bukowych, porównano osiągnięte wyniki z wynikami badań mikologicznych w buczynach górskich południowo-wschodniej Polski (ryc. 1) oraz innych krajów europejskich w obrębie zasięgu buka (ryc. 2).

Jako podstawę do obserwacji mikologicznych przyjęto stałe powierzchnie po 400 m². Wielkość ta okazała się optymalna dla prowadzenia tego rodzaju badań w tak zróżnicowanych florystycznie zespołach leśnych, jak buczyny i inne pokrewne im zbiorowiska roślinne. Na każdej powierzchni przez 2-3 sezony wegetacyjne notowano ilość owocników każdego gatunku grzyba. Jako zdjęcie w sensie mikosocjologicznym należy przyjąć sumę wszystkich notowań grzybów na danej powierzchni.

Na podstawie uzyskanych danych, dotyczących ilościowości (według skali Mosera 1949) owocujących grzybów oraz charakteru podłoża, zestawiono syntetyczne tabele (tab. 1, 2, 3). Obejmują one wszystkie gatunki grzybów badanych lasów bukowych w północno-zachodniej Polsce — 330 gatunków, 3 odmiany i 5 form.

Na podstawie rozważań wielu autorów nad rolą grzybów wyższych w strukturze fitocenozy oraz w oparciu o własne obserwacje nad udziałem grzybów w różnych zespołach leśnych, można wysnuć następujące wnioski:

1. Grzyby wyższe mikoryzowe oraz saprofity owocujące na glebie wykazują najściślejsze powiązanie z określonym zbiorowiskiem roślin kwiatowych. Stanowią więc one synuzje, czyli strukturalno-funkcjonalny element danej fitocenozy. Wśród grzybów naziemnych można znaleźć najwięcej gatunków wskaźnikowych, charakteryzujących nie tylko zespół leśny, ale wyróżniających również niższe jednostki fitosocjologiczne (podzespoły, facje) w zależności od warunków siedliskowych i składu florystycznego, głównie drzew.

2. Grzyby wytwarzające przeważnie drobne owocniki na opadłych liściach, owocach oraz innych szczątkach roślinnych i zwierzęcych związane są nieco bardziej z podłożem na którym rosną. Częściej niż grzyby naziemne spotyka się je w zbiorowiskach pokrewnych, jeśli znajdą tam odpowiedni substrat. Jednak i ta grupa ekologiczna macromycetes zdaje się również tworzyć synuzje, ponieważ najlepsze warunki dla rozwoju znajduje w jednym zespole roślinnym, ewentualnie w kilku zbiorowiskach należących do jednego związku. Stąd grzyby zasiedla-

jące opadłe, nierozłożone jeszcze liście i owoce mogą charakteryzować grupy zespołów danego związku.

3. Grzyby nadrzewne zdają się być najbardziej związane z podłożem, na którym występują. Jednakże w tej grupie nie wszystkie gatunki w jednakowym stopniu uzależnione są od swego substratu. Nie ma zbyt wyraźnej granicy między synuzjami grzybów rosnących na opadłych liściach i owocach a grupą grzybów owocujących na leżących w ściółce gałązkach bukowych. Wśród tych ostatnich wyodrębnić można kilka gatunków, z których jedne dobrze charakteryzują lasy bukowe niżowe i górskie, inne preferują bądź to żyzne buczyny niżowe bądź to żyzne buczyny górskie. Nie przechodzą one do zbiorowisk pokrewnych mimo obecności odpowiedniego substratu.

Nieco inaczej należałoby traktować macromycetes owocujące na murszejących pniakach i kłodach. Jak wykazały badania różnych autorów, grzyby te reagują na stopień rozkładu drewna. Inne gatunki owocują na świeżym drewnie złomów i wykrotów, inne na częściowo zmurszałym, a jeszcze inne na silnie spróchniałych, rozkładających się pniakach i kłodach. Tę grupę ekologiczną grzybów zasiedlających murszejące drewno można uważać za składnik zespołu zależnego wraz z innymi roślinami zarodnikowymi (mszaki, porosty, śluzowce), a zmiany w składzie gatunkowym w miarę postępującego próchnienia drewna interpretować jako kolejne stadia sukcesyjne tego zespołu, tj. stadium inicjalne, optymalne i terminalne (Kreisel 1961).

Podobnie grzyby pasożytujące i saprofityczne na pniach i korzeniach żywych buków tworzą zespoły zależne, mające do pewnego stopnia odrębny charakter. Zespoły te pozostają jednak pod wpływem warunków fitoklimatycznych panujących w określonym zbiorowisku leśnym. Jak wykazały badania prowadzone w różnych zbiorowiskach buczyn w Europie Środkowej, wiele gatunków grzybów wchodzących w skład zespołów zależnych roślin zarodnikowych rozwijających się na drewnie bukowym jest bardziej przywiązanych do zespołu lasu bukowego aniżeli do innych pokrewnych zbiorowisk leśnych.

W oparciu o wyżej przedstawiony podział na trzy zasadnicze grupy według mikrosiedlisk przedstawiono udział macromycetes w poszczególnych zbiorowiskach lasów bukowych na obszarze północno-zachodniej Polski i porównano je z mikoflorą buczyn innych krajów Europy (tab. 4a, b, c).

Spostrzeżenia mikologiczne poczynione w podzespole *Melico-Fagetum cephalantheretosum rubrae* potwierdzają swoistość tego zbiorowiska w stosunku do innych podzespołów żyznej buczyny niżowej. Być może mikoflora mogłaby tu stanowić jeden z argumentów przemawiających za zaliczeniem tego zbiorowiska do podzwiązku *Cephalanthero-Fagion*, jak sugeruje Matuszkiewicz (1958). Należałoby jednak zbadać udział grzybów jeszcze w innych zespołach zaliczanych do tego podzwiązku. Z drugiej strony już obecnie można stwierdzić, że z wilgotnym i żyznym zespołem *Mercuriali-Fagetum* omawiany podzespół posiada bardzo mało wspólnych gatunków grzybów.

Zbiorowiska acidofilnych lasów bukowych i bukowo-dębowych z uwagi na nie ustalone dotąd poglądy fitosocjologów co do ich przynależności systematycznej zestawiono łącznie, wydzielając jedynie postać trawiastą z dominującą roślinnością kwiatową (głównie trawami) i postać mszystą.

Podobnie jak rośliny naczyniowe, grzyby wyższe potwierdzają pośrednie stanowisko zbiorowiska określanego przez fitosocjologów jako zespół *Fago-Quercetum* między żyzną buczyną (*Melico-Fagetum*) a borem mieszanym (*Pino-Quercetem*).

Płaty acidofilnych buczyn z dobrze rozwiniętą warstwą mszystą a ubogim runem, tak na Pomorzu Zachodnim jak w Niemczech (Wzgórza Wezerskie) i w Danii (Fionia), posiadały specyficzną florę macromycetes. Główną rolę odgrywały w nich grzyby naziemne briofilne i acidofilne. Wyraźna różnica w stosunku do postaci trawiastej zaliczanej do zespołu *Fago-Quercetum typicum* potwierdza przypuszczenie Piotrowskiej i Żukowskiego (1967), że to mszyste zbiorowisko, dość często spotykane w obrębie wału moren pomorskich, może zasługiwać na rangę samodzielnego zespołu.

Porównując pod względem mikoflory lasy bukowe Polski z buczynami środkowej i południowej Europy, można dostrzec dość znaczne podobieństwo między nimi. Więcej gatunków wspólnych z lasami jodłowo-bukowymi Czechosłowacji, Węgier i Jugosławii posiadały polskie buczyny górskie aniżeli buczyny niżowe, w których brak jodły i świerka. Ilość gatunków grzybów wyższych wspólnych z żyzną buczyną niżową wahała się od 26-64% (tab. 5).

Analiza flory macromycetes badanych buczyn na tle pokrewnych zespołów leśnych świadczy o dość szerokiej skali ekologicznej grzybów występujących w tych lasach. Spośród grzybów naziemnych wiele gatunków znalezionych w higrofilnym i eutroficznym zespole *Mercuriali-Fagetum* podawano z olesów i łęgów. Płaty żyznego podzespołu typowego *Melico-Fagetum* i formy podgórskiej *Dentario glandulosae-Fagetum* posiadały szereg gatunków wspólnych ze zbiorowiskami grądowymi. Acidofilne lasy bukowe i bukowo-dębowe nawiązywały pod względem mikoflory do borów mieszanych i jodłowych, a buczyny górskie — do lasów i borów jodłowych.

Stwierdzono istnienie licznej grupy grzybów rosnących najczęściej w zbiorowiskach lasów bukowych, a spotykanych także w pokrewnych zespołach leśnych zarówno z udziałem buka jak i bez jego domieszki. Należą do niej m.in.: *Lactarius piperatus*, *L. subdulcis*, *L. vellereus*, *Russula lepida*, *R. alutacea*, *R. fellea*, *R. cyanoxantha*, *R. nigricans*, *Phallus impudicus*, *Craterellus cornucopioides*, *Tricholoma sulphureum*, *Clitocybe fragrans*, *C. hydrogramma*, *C. odora*, *Mycena stylobates*, *M. filopes*, *M. vitilis*,* *M. galericulata*, *Collybia peronata*, *C. butyracea* var. *asema*, *Marasmius rotula*, *M. bulliardii*, *Polyporus varius* var. *nummularius*, *Tremella mesenterica*, *Kuehneromyces mutabilis*, *Oudemansiella platyphylla* i *O. radicata*. Gatunki te uznać można za charakterystyczne dla rzędu *Fagetalia*.

Badania porównawcze w pokrewnych zespołach leśnych z udziałem buka dowiodły, że drzewo to wpływa w znacznym stopniu na skład mikoflory zbiorowiska w którym występuje, wprowadzając szereg gatunków grzybów z nim związanych. Wpływ buka zaznacza się w synuzji grzybów naziemnych (*Lactarius blennius*, *L. pallidus*, *Hygrophorus eburneus*, *Russula mairei*, *Coprinus picaceus*), w synuzji grzybów na opadłych owocach buka (*Dasyscyphus virgineus*, *Phaeomarasmius carpophilus*, *Xylosphaera carpophila*), a przede wszystkim w zbiorowiskach grzybów nadrzewnych.

Jak wykazały obserwacje własne przeprowadzone w różnych zbiorowiskach lasów bukowych Polski oraz materiały porównawcze w szeregu krajów w zasięgu buka w Europie, następujące gatunki grzybów wyższych przyjąć można za charakterystyczne dla badanych lasów bukowych związku *Fagion silvaticae* Tx. et Diem. 1936:

a) Grzyby naziemne

preferujące ciepłolubne buczyny na podłożu alkalicznym:

Tricholoma pardinum, *Russula maculata*, *R. olivacea*, *Boletus satanas*, *B. luridus*, *Cortinarius largus*, *Inocybe petiginosa;*

preferujące żyzne buczyny na podłożu słabo kwaśnym:

Helvella crispa, *Boletus erythropus*, *B. appendiculatus*, *Strobilomyces flocco-*

pus, Stropharia squamosa, Russula solaris, R. grisea var. *xanthochlora, Tricholoma ustale;*

preferujące żyzne buczyny górskie:

Porphyrellus pseudoscaber, Cortinarius nemorensis, C. torvus, Hygrophorus pudorinus, Phylloporus rhodoxanthus;

b) Grzyby na opadłych liściach i owocach buka

preferujące buczyny niżowe:

Marasmius splachnoides, M. recubans, Tubaria pellucida;

preferujące buczyny górskie:

Mycena fagetorum, M. capillaris, Collybia fuscopurpurea, Marasmus prasiosmus.

c) Grzyby na opadłych gałązkach i drewnie bukowym

preferujące żyzne buczyny niżowe:

Hydropus subalpinus, Polyporus forquignoni;

preferujące żyzne buczyny górskie:

Hericium coralloides, Omphalina epichysium, Inonotus radiatus var. *nodulosus*

charakterystyczne dla lasów bukowych niżowych i górskich:

Marasmius alliaceus, Mycena crocata, Pycnoporus cinnabarinus, Oudemansiella mucida.