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Response of macrofungi to mosaic arrangement of biotic microforms in the *Ribo nigri-Alnetum* in the Olszyny Niezgodzkie reserve

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Results of a three-year study carried out on permanent plot are presented and distribution patterns of macrofungi within the hummock-hollow complexes are discussed.

Key words: mycocoenology, macrofungi, *Ribo nigri-Alnetum*, biotic microforms, nature reserve.

INTRODUCTION

Bog-alder forests are an outstanding example of a mosaic plant community. Their mosaic character is manifested as the hummock-hollow structure of the undergrowth, which is characterised by considerable stability.

In Poland, in particular in its western part, bog-alder forests are relatively rare. One of the largest regions of their occurrence is the Barycz river valley where alder forests cover an area of about 900 hectares (Marek 1965). A considerable part of the valley has been turned into a landscape park preserve Dolina Baryczy founded in 1996.

The hummock-hollow structure of bog-alder forests determined by the vertical fluctuation of water is not always clearly formed. Model examples of a well-developed hummock-hollow system are fragments of bog-alder forests in the Olszyny Niezgodzkie reserve near Żmigród, which have been under protection since 1987. The movement of water in the area is controlled and intense because of the presence of fish ponds established in 12th century (Marek 1965). The reserve is a unique example of typical bog-alder forest structure not met in Lower Silesia and rarely met in the other regions of Poland (Czubiński et al. 1977).

In the Olszyny Niezgodzkie reserve mycological studies on macromycetes have not been hitherto performed. The studies carried out there concerned the dynamics of seasonal changes in the flora of soil fungi and *Actinomycetes* as well as cellulolytic activity of these microbes in the hummock-hollow biotopes (Z a b a w s k i et al. 1976).

The paper presents preliminary results of three-year observations on the occurrence of macromycetes in bog-alder forests in the Olszyny Niezgodzkie reserve and their spatial distribution.

I wish to pay tribute to my great tutor Prof. Zygmunt Czubiński, who inspired me to take up studies of bog-alder forests and riverside forests. I am much indebted to Prof. Jerzy Fabiszewski for drawing my attention to the wonderful bog-alder forests near Niezgoda. Thanks are also due to Eng. Stefan Wojciechowski (Żmigród Forest Inspectorate) for his kind help during my field studies, to Dr Andrzej Brzeg for making the phytosociological relevé and to Ms Władysława Ciesiółka for help in technical elaboration of the manuscript.

STUDY AREA

The Olszyny Niezgodzkie reserve is situated in the Niezgoda forest district, inspectorate Żmigród, and is administered by the Regional Administration of State Forests in Wrocław. It is localised midway between Żmigród and Milicz. The reserve spreads over an area of 74.28 hectares from northeast to southwest. From the west it is bordered by a hardened forest track from Niezgoda to Ruda Żmigrodzka, while from the east – by the small river Ługa, which is a tributary of the river Barycz. The forests are about 1km SE from the Niezgoda village (Fig. 1).

The area of the reserve is situated between the 51°31′ north latitude and 17°01′ east longitude. The altitude of the area is rather small and on the average equals 90 m above the sea level.

The beds of alder forest peat and rush peat (Z a b a w s k i et al. 1978) of about 1 m in depth are deposited on the Quaternary formations of glacial and riverbed origin, mainly on sands and gravel. The alder forest phytocoenoses occur on boggy peat soil (M a r e k 1965).

According to climatic division by W o ś (1994, 1995) the area of the reserve belongs to the 16th Region – Południowa Wielkopolska. It is characterised by a relatively high number of warm and sunny days. Sunny or cloudy days with moderate temperature without precipitation are much more frequent than in other regions. Also more frequent than elsewhere are days with ground frost type of weather. Because of the abundance of waters, the climate of the river Barycz valley is somewhat cooler than in the other parts of Lower Silesia. The vegetation period lasts 210 days and the average sum of precipitation is of about 550 mm (P e n d e r et al. 1995). The hydrological conditions of the area are favourable, to a large extent stabilised and affected by the water control system of the fishponds.

In terms of the geobotanic division by S z a f e r (1972), the area belongs to the Wielkopolsko-Kujawski region, Barycz district and Żmigrodzka Valley,

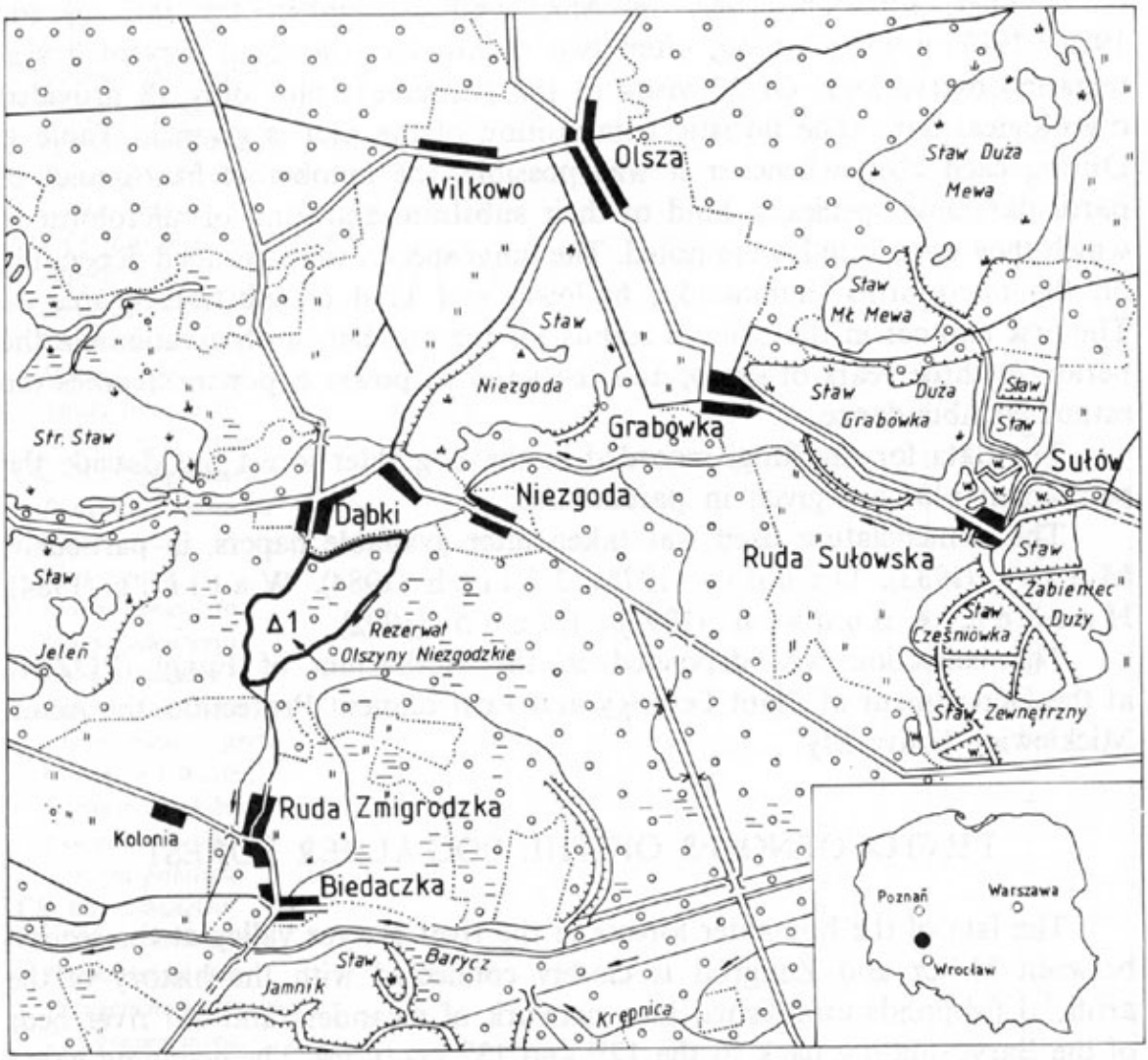

Fig. 1. Location of the research area in the Barycz river valley (drawn by Antoni Szwed)
1 — permanent observation plot

and it is well forested. Matuszkiewicz (1993) classified the alder forest landscape of this area as belonging to the Bradenburg-Wielkopolska Section, district of the river Barycz Valley and subdistrict of Żmigród. The alder forests of Niezgoda surround many artificial fishponds (nurseries) established in cut-off meanders and old river bed of the river Barycz and its tributaries. The area surrounding the Olszyny Niezgodzkie reserve is a potential habitat of forest carrs of the *Circaeo-Alnetum* and *Ficario-Ulmetum campestris* type (Wojterski et al. 1981).

METHODS

A permanent plot of an area of 400 m^2 in the phytocoenosis of alder forest *Ribo nigri-Alnetum* Sol.-Górn. 1987 was established in May 1985. The observations of fungi fruit-bodies (macromycetes) were performed from May

to October, sometimes also in April and November, for three years: 1985–1987. A long lasting, often two month long flooding prevented systematic observations. Of 22 visits to the permanent plot only 18 provided mycological data. The floristic composition of the plot is given in Table 1. During each visit, whenever it was possible, the number of fruit-bodies of particular fungi species, a kind of their substrate and kind of microform in which they were found, were noted. The fungi species were grouped depending on the microforms (hummocks, hollows) and kind of substrate (Table 2). The first number in the column stands for the number of observations in the period of three years of study, and the letter in power exponent denotes the estimated abundance.

The data for the fungi recorded in the bog-alder forest but outside the permanent plot are given in parentheses.

The nomenclature used was taken after available papers, in particular: Moser (1983), Dennis (1978), Jülich (1984), Watling (1984), Hansen, Knudsen (1997), Lizoń (1992).

The collection was deposited in the Herbarium of Fungi (POZM), at the Department of Plant Ecology and Environment Protection, the Adam Mickiewicz University.

PHYTOCOENOSES OF THE BOG-ALDER FOREST

The fate of the bog-alder forests in the river Barycz valley at the section between Milicz and Żmigród is closely connected with the history of the artificial fishponds established in a network of meanders and old river beds of the Barycz dating back to the 12th and 13th centuries. The economy based

Table 1

Ribo nigri-Alnetum in the Olszyny Niezgodzkie reserve (the Barycz river valley)

Date	17 Aug. 1999
Density a	70
b	5
Cover c	75
d	25
Age	III–IV
Height of trees in m	30
Average diameter in cm	32
Area of record	400
Number of species	56
Trees	
Alnus glutinosa a	4.4
Alnus glutinosa b	1.2
Alnus glutinosa c	+
Sorbus aucuparia b	+
Sorbus aucuparia c	+
Fraxinus pennsylvanica b	+

Ch. Ass. *Ribo nigri-Alnetum* et All. *Alnion glutinosae*	
Ribes nigrum b	+.2
Solanum dulcamara	1.2
Thelypteris palustris	1.2
Lycopus europaeus	+.2
Calamagrostis canescens	+
Carex elongata	+
Ch. Cl. *Lemnetea* et *Potametea*	
Lemna minor c	2.3
Callitriche cophocarpa	1.2
Lemna trisulca	1.2
Hottonia palustris	1.2
Riccia fluitans d	2.3
Ricciocarpus natans	+
Ch. Cl. *Phragmitetea*	
Phragmites australis	2.3
Carex riparia	2.2
Carex elata	1.2
Carex paniculata	1.2
Iris pseudoacorus	1.2
Galium palustre	1.2
Carex acutiformis	+.2
Carex pseudocyperus	+.2
Oenanthe aquatica	+
Rorippa amphibia	+
Peucedanum palustre	r
Rorippa palustris	r
Ch. Cl. *Bidentetea*	
Bidens frondosa	2.3
Bidens tripartitus	1.1
Polygonum hydropiper	1.2
Polygonum minus	1.1
Ranunculus sceleratus	+
Bidens cernua	+
Accompanying species	
Urtica dioica c	1.2
Lysimachia thyrsiflora	+.2
Myosoton aquaticum	+
Rubus idaeus	+
Athyrium filix-femina	+o
Deschampsia caespitosa	+o
Barbaraea stricta	r
Lythrum salicaria	r
Quercus robur	r
Pinus silvestris	r
Hypnum cupressiforme d	2.2
Amblystegium riparium	1.2
Dicranoweisia cirrhata	1.2
Mnium hornum	1.2

Sporadic: *Brachythecium salebrosum* (+.2); *Calliergonella cuspidata* (+.2); *Cladonia coniocrea* (+.2); *C. digitata* (+.2); *Drepanocladus aduncus* (+.2); *Eurhynchium hians* (+.2); *Leucobryum glaucum* (+.2); *Polytrichum longisetum* (+.2); *Atrichum undulatum* (+); *Plagiothecium nemorale* (+).

Relevé made by Dr A. Brzeg.

on fish nursing ponds favoured development as well as preservation and stability of these communities. The originally smaller area of bog-alder forests expanded following the expanding complex of fishponds (M a r e k 1965). In the period between World War I and II, the bog-alder forests near Niezgoda were under government protection. After World War II the forests were subject to excess felling, in particular in the 70s and the 80s. The appeals for taking the forests under protection were for a long time ignored (M a r e k 1970; Z a b a w s k i et al. 1982; Z a b a w s k i and Ż u r a w s k a 1978). From the originally planned protection of a few hundred hectares of bog-alder forest peats, finally the protection of a few percent (74 ha) was carried into effect, and these are the Olszyny Niezgodzkie reserve in the 63–67 section of Niezgoda forest district (Fig. 1). Strong flooding of the area, lasting for a few months and mild climate (no frozen ground), made this area inaccessible and useless for economy. The reserve encompasses the oldest parts of the bog-alder forest, of about 90 years of age.

The bog-alder forests of the reserve grow on the flooded terrace of the river Ługa, whose regulation and embankment performed in recent years significantly deteriorated the water conditions in the reserve. Despite these disturbing changes, the classically developed and reaching even up to 2m high hummocks of black alder covered with a thick carpet of moss, sedges and ferns, maintain the unique primeval character of these forests. A characteristic feature of the alder forests near Niezgoda is a regular autumn flooding related to the water control in fishponds, spring flooding happens sporadically. Usually in September, the water released from the fishponds floods the hollows and it remains at a high level for a rather long time, often till November. In the years of the study, the area was flooded and inaccessible from September to November in 1985, from October to November in 1986, and in 1987 only in April.

The vegetation cover of the Olszyny Niezgodzkie reserve has been recently described by the workers from the University of Wrocław (P e n d e r and A n i o ł-K w i a t k o w s k a 1995). The phytosociological relevé made in the permanent plot area, section 66b, reflects the characteristic combination of the species from the *Ribo nigri-Alnetum* association and *Alnion* alliance. The periodical flooding results in the presence of plants from the *Lemnetea* and *Potametea* classes (Table 1). The contribution of the species from non-forest communities representing the *Phragmitetea* and *Bidentetea* classes, growing mainly in hollows, is also significant. Among the more interesting plants occurring in the area are the suboceanic species *Hottonia palustris*, very rarely noted in Lower Silesia *Lysimachia thyrsiflora* and *Barbaraea stricta* and protected *Ribes nigrum*.

The floristic composition of phytocoenoses of the alder forest studied is relatively homogeneous. The reason for a small contribution of foreign species is probably a large area taken by the patches of this forest association and the fact that it is surrounded by alder and elm carrs, whose habitats are similar.

DISTRIBUTION OF MACROMYCETES IN THE BOG-ALDER FOREST

Fungi are very sensitive indicators of changes taking place in a habitat. In bog-alder forests, where the diversity of habitats and richness of substrates is particularly high, this indicative role of fungi is even more pronounced (B u j a k i e w i c z 1973). In response to a coupled functional system of hummocks and hollows (Fig. 2), the distribution of fungi is characterised by certain regularity in occurrence on microforms and suitable substrates (Tables 2 and 3).

H u m m o c k s. The system of adventitious roots of alder trees, elevated above the ground, stimulates the formation of broad hummocks, looking like big mounds of rather steep and irregular slopes. A hummock supported by the scaffolding of the adventitious roots assumes the shape of an empty inside cup. The oscillating water horizon washes out the rotting matter from the bottom part of the hummock and leaves voids, which isolate the hummock from the influence of the substrate. Therefore the rotting matter on the hummock is mainly under the influence of precipitation in the ombrophilous regime.

The surface of the hummock is covered with a layer of litter composed of the remains of alder trees (leaves, alder cones, catkins, etc.). Under the litter there is a dense carpet of moss growing on the layer of rotting matter through which the alder tree roots grow. On the hummocks, elevated on average up to 1 m (maximum elevation 1.5—2.0 m), there are extremely oligothrophic conditions. The carpet of moss is composed mainly of the species related to acidophilous habitats. At the top parts the hummocks are periodically overdried and lichens start to appear there (*Cladonia coniocrea*, *C. digitata*) (Table 1).

On the hummocks in the alder forests in the Olszyny Niezgodzkie reserve very few fungi species occur, but they show a particularly interesting spatial, and especially vertical distribution. They grow in at least three different zones of the vertical structure of the hummock (Table 3).

From the root neck, of the alder tree trunks grows a parasite fungus *Pholiota alnicola*. The fruit bodies of this species are found on the surfaces among the adventitious roots of the tree. In the top part of the hummock, among abundant deciduous litter, the presence of *Mycena sanguinolenta* was noted, in most cases after rainfalls. These are the sites highly unfavourable for development of fungi fruit-bodies. The slopes of the hummocks, covered with the carpet of moss (*Hypnum cupressiforme*, *Mnium hornum*, *Leucobryum glaucum*) are the sites of occurrence of bryophilous fungi, mainly *Galerina hypnorum* and *Ricknella fibula*. Sporadic presence of individual fruit-bodies of the ectomycorrhizal fungi *Lactarius obscuratus* and *L. omphaliformis* was also noted there. In dry seasons, when the usually compact carpet of moss shrinks and separates, no fruit-bodies of any fungi, even bryophilous ones, were found.

Table 2

Macromycetes of biotic microforms and various substrates of *Ribo nigri-Alnetum* in the Olszyny Niezgodzkie reserve

Years of observations	1985–1987
Area of observation plot in sq. m	400
Number of observations	22
Number of species	107
HOLLOWS	
Ground	
Scutellinia scutellata (L. ex St. Am.) Lamb.	14^{a}
Conocybe rickeniana P.D. Orton	9^{a-a}
Naucoria scolecina (Fr.) Quél.	9^{a-a}
Naucoria escharoides (Fr.: Fr.) Kummer	6^{r-n}
Lactarius obscuratus (Lasch) Fr.	4^{n}
Lactarius omphaliformis Romagn.	3^{n}
Cortinarius helvelloides (Fr.) Fr.	1^{n}
Litter	
Hymenoscyphus consobrinus (Boud.) Arnolds et Baral	14^{a}
Psathyrella candolleana (Fr.) Maire	12^{a-a}
Mycena speirea (Fr.: Fr.) Gill.	10^{r-n}
Hymenoscyphus repandus (Phillips) Dennis	7^{r-a}
Tubaria conspersa (Pers.: Fr.) Fayod	6^{r-n}
Tapesia fusca (Pers. ex Mérat) Fuck.	6^{n}
Ciboria uliginosa Fr.	6^{r}
Lachnum controversum (Cooke) Rehm	5^{a}
Mo*Physarum bivalve* Pers.	3^{a}
Ciboria conformata (Karst.) Svrst.	2^{a}
Ciboria viridifusca (Fuck.) von Höhnel	2^{r}
Hymenoscyphus imberbis (Bull.: Fr.) Dennis	2^{r}
Lachnum pubibundum (Quél.) Schröt.	2^{r}
Calyptella capula (Holmsk.: Fr.) Quél.	1^{a}
Mo*Diachaea leucopodia* (Bull.) Rost.	1^{a}
Mollisia amenticola (Sacc.) Rehm	1^{a}
Hymenoscyphus caudatus (P. Karst.) Dennis	1^{a}
Typhula erythropus (Pers.) Fr.	1^{a}
Typhula setipes (Grev.) Berthier	1^{a}
Hymenoscyphus scutulus (Pers.: Fr.) Phillips	1^{n}
Coprinus plicatilis (Curt.: Fr.) Fr.	1^{r}
Lachnum virgineum (Batsch: Fr.) Karst.	1^{r}
Dung	
Ascobolus furfuraceus Pers.: Fr.	3^{n}
Cheilymenia stercorea (Pers.: Fr.) Boudier	1^{n}
Coprinus stercoreus Fr.	1^{n}
Loose wood, bark	
Delicatula integrella (Pers.: Fr.) Fayod	6^{n}
Mycena haematopus (Pers.: Fr.) Kummer	4^{n}
Branches, boughs	
Stereum hirsutum (Willd.: Fr.) S.F. Gray	5^{n}
* *Schizopora paradoxa* (Schrad.: Fr.) Donk	4^{n}
* *Peniophora erikssonii* Boid.	2^{n}
Vuilleminia comedens (Nees: Fr.) Maire	2^{n}
+ *Lasiosphaeria ovina* (Pers.: Fr.) Ces. et de Not.	2^{r}

Steccherinum ochraceum (Pers. in Gmelin: Fr) S.F. Gray	2^{r}
+*Godronia ribis* (Fr.) Seaver	1^{a}
+*Melanconium sphaeroideum* Link: Fr.	1^{a}
* *Datronia mollis* (Sommerf.: Fr.) Donk	1^{n}
+*Hypoxylon rutilum* Tul.	1^{n}
* *Radulomyces confluens* (Fr.) M.P. Christ.	1^{n}
Oudemansiella platyphylla (Pers.: Fr.) Mos.	1^{r}
Polyporus brumalis (Pers.) Fr.	1^{r}
Tubercularia vulgaris Tode: Fr.	1^{r}
Logs	
Stereum subtomentosum Pouz.	18^{n}
Scutellinia scutellata (L. ex St. Amans) Lambotte	14^{a}
Hypoxylon multiforme (Fr.) Fr.	13^{n}
* *Loweomyces fractipes* (Berk. et Curt.) Jülich	8^{r-n}
Exidia plana (Wigg. ex Schleich.) Donk	8^{n}
Pluteus cervinus (Schaeffer) Kummer	7^{r}
Ganoderma applanatum (Pers.) Pat.	6^{n}
Orbilia xanthostigma (Fr.) Fr.	5^{n}
Bjerkandera adusta (Willd.) P. Karst.	(5^{n})
Calocera cornea (Batsch) Fr.	4^{n}
Antrodiella hoehnelii (Bres. ex Höhn.) Niemelã	3^{n}
Fomes fomentarius (L.: Fr.) Fr.	3^{n}
M*Lycogala epidendrum* (L.) Fr.	3^{n}
Hohenbuehelia atrocoerulea (Fr.) Sing.	3^{n}
Trametes versicolor (L.) Pil.	3^{n}
Panellus serotinus (Pers.: Fr.) Kühn.	(3^{n})
Panus tigrinus (Bull.) Sing.	3^{r}
Merulius tremellosus Fr.	2^{n}
* *Rigidoporus vitreus* (Fr.) Donk	2^{n}
Pluteus luctuosus Boud.	2^{r}
Pluteus pellitus (Pers.: Fr.) Kummer	1^{n}
Coprinus domesticus (Bolt.: Fr.) S.F. Gray	1^{r}
Daedaleopsis confragosa (Bolt. ex Höhn.) Niemelä	1^{r}
Fomitopsis pinicola (Sw.) P. Karst.	1^{r}
Galerina heimansii W. Reijnders	1^{r}
* *Steccherinum robustius* (John Erikss. et Lundell) John Erikss.	1^{r}
Standing dead trees and stumps	
Inonotus radiatus (Sow.: Fr.) P. Karst.	6^{n-a}
Panellus stypticus (Bull.) P. Karst.	4^{n}
Hapalopilus nidulans (Fr.) P. Karst.	3^{r}
Mycena tintinnabulum (Fr.) Quél.	2^{a}
Stereum rugosum (Pers.: Fr.) Fr.	1^{a}
Chondrostereum purpureum (Pers.) Pouz.	1^{n}
Mycena inclinata (Fr.) Quél.	1^{n}
HUMMOCKS	
Trunks of living trees	
Pholiota alnicola (Fr.) Sing.	3^{n}
M*Reticularia lycoperdon* Bull.	2^{r}
Top and slope	
Among mosses	
Galerina hypnorum (Schrank.: Fr.) Kuehn.	7^{r-n}
Rickenella fibula (Bull.) Raith.	5^{r-n}

Tab. 2 cont.

Years of observations	1985–1987
Area of observation plot in sq. m	400
Number of observations	22
Number of species	107
Rickenella setipes (Fr.) Raith.	4^{r}
Mniopetalum globisporum Donk	3^{n}
Lactarius omphaliformis Romagn.	1^{n}
Cordyceps 272[1]/	1^{r}
Cystoderma amiantinum (Scop.: Fr.) Fayod	1^{r}
Lactarius obscuratus (Lasch) Fr.	1^{r}
Among litter	
Mycena sanguinolenta (Ab. et Schw.: Fr.) Kummer	7^{r-n}
On advetitious roots	
Chondrostereum purpureum (Pers.) Pouz.	8^{n}
Mycena galericulata (Scop.: Fr.) S.F. Gray	7^{r-n}
Mycena niveipes Murr.	2^{r}
Pholiota alnicola (Fr.) Sing.	1^{n}
Tubaria conspersa (Pers.: Fr.) Fayod	1^{r}
Bottom	
Naucoria scolecina (Fr.) Quél.	9^{n-a}
Naucoria escharoides (Fr.: Fr.) Kummer	6^{r-n}
Cortinarius helvelloides (Fr.) Fr.	1^{n}
Outside the plot, alder forest edge: *Trametes gibbosa* (Pers.) Fr.; *Ganoderma lucidum* (Curt.) P. Karst.; *Xylaria hypoxylon* (L.) Grev. *Trametes hirsuta* (Wulf.) Pil.; *Hypholoma fasciculare* (Huds.) Kummer.; *Pluteus salicinus* (Pers.) Kummer; *Phallus impudicus* L.; *Scleroderma citrinum* Fr.; *Mycena tintinnabulum* (Fr.) Quél.	

Explanations: 1, 3, 14 – number of records; r, n, a – degree of abundance (Jahn et al. 1967); a – abundant, n – numerous, r – rare; * – det. Åke Strid; + – det. Andrzej Chlebicki; o – det. Anna Drozdowicz; 1/ under elaboration, undescribed species (Bałazy, personal communication); M – *Myxomycota.*

On the slopes of somewhat lower and more humid hummocks, on alive stems of *Mnium hornum*, there were fine shell-like fruit-bodies of the parasite species *Mniopetalum globisporum.*

The adventitious roots of alder trees are grown with resupinate fruit--bodies of *Chondrostereum purpureum* – a parasite species occurring on many deciduous trees, and *Mycena galericulata.*

At the foot of the hummocks, among the litter placed on a characteristic structure of the horizontal roots of alder, the abundance of fruit-bodies of the ectomycorrhizal fungi *Naucoria solecina* and *N. escharoides* is usually found. In periods of low water horizon, sometimes strings of fruit-bodies of these species were observed to run from the foot of the hummock long into the hollows.

The appearance of fruit-bodies of the ectomycorrhizal species was characterised by certain time regularities. The fruit-bodies of *Naucoria solecina* were noted from June to the end of the season, while those of *Naucoria escharoides* mainly in autumn (October and November). A similar regularity was observed in the appearance of *Lactarius omphaliformis* (July, August) and

Mycena sanguinolenta
Galerina hypnorum
Mniopetalum globisporum
Lactarius obscuratus
Cystoderma amiantinum
Pholiota alnicola
Chondrostereum purpureum
Mycena galericulata
Mycena niveipes
Naucoria scolecina
Naucoria escharoides
Cortinarius helvelloides
Inonotus radiatus
Panellus stypticus
Hapalopilus nidulans
Stereum subtomentosum
Scutellinia scutellata
Mycena speirea
Lowemyces fractipes
Orbilia xanthostigma
Panus tigrinus
Pluteus pellitus
Stereum hirsutum
Peniophora ericksonii
Vuilleminia comedens
Cheilymenia stercorea
Coprinus stercoreus
Mycena haematopus
Delicatula integrella
Psathyrella candolleana
Lachnum controversum
Hymenoscyphus consobrinus
Conocybe rickeniana

scheme acc. to Marek (1965) (modified)

L. obscurantus (September – November). The species *Cortinarius helvelloides* occurred only in autumn (September).

H o l l o w s. The diversity of habitats in the reserve is determined by hydrological conditions. The hollows among the hummocks are flooded every year, usually in the time of the autumn catch of carps, when water from the fishponds is released. Therefore, peat in the hollows is constantly affected by stagnant water. The constant excess of water stimulates abundant development of vegetation, particularly pronounced in July and August.

In the hollows the fungi grew in seven different groups of substrates (Table 2). The most abundant were epixylic fungi growing on logs partly submerged in boggy ground or hanging between the hummocks, on branches of alder trees laying on the forest floor and on stumps and standing dead trees. On these substrates, a mass appearance of such species as *Stereum subtomentosum*, *Scutellinia scutellata*, *Orbilia xanthostigma* and *Panus tigrinus* was noted (Fig. 3). The logs suspended over the water table were grown with *Pluteus pellitus*. The standing dead alder trees were abundantly covered with *Inonotus radiatus*, the most common parasite species, attacking the trunks of black alder trees (D o m a ń s k i 1955). Also, *Stereum hirsutum* was observed.

An interesting finding was the abundant presence of the species *Loweomyces fractipes*, favouring moist biotopes and growing on periodically flooded logs of *Alnus*, *Fraxinus*, *Betula* and *Salix* (W i n t e r h o f f 1993). It is rare in Poland and in other countries of Central Europe, and belongs to highly endangered species (Rote Liste 1992, 1996). This fungus was noted also in the flooded forests in the East states of the USA (B u j a k i e w i c z 1985).

Separate rotting parts of alder wood lying on the ground are most often chosen by two species *Delicatula integrella* and *Mycena haematopus*.

The group of fungi related to the litter composed of rotting leaves, stems of herbaceous plants, blades of grasses and sedges occupying the hollows is rather large. There is a mass appearance of *Hymenoscyphus consobrinus* on remains of such plants as *Bidens* and *Lysimachia* (G r a u w i n k e l 1987) (Fig. 4). The sticks of *Phragmites australis* are covered with fine fruit bodies of *Lachnum controversum*, whereas fine branches of alder trees are often grown with *Hymenoscyphus repandus*.

The litter is the site of occurrence of *Psathyrella candolleana*, *Mycena speirea* and *Tubaria conspersa*. In certain years, e.g. 1985, 1987, in July and August, a mass appearance of *Physarum bivalve*, the species rare in Poland, was noted on plant remains.

There were relatively few species growing in the hollows directly on the boggy soil; these were mainly saprothropic fungi such as *Scutellinia scutellata* and the nitrophilous species *Conocybe rickeniana* forming abundant groupings of very fine fruit bodies in the hollows (Fig. 5). Among sometimes compact carpets of *Amblystegium riparium* the presence of a few species of ectomycorrhizal fungi such as *Naucoria escharoides*, *N. scolecina*, *Lactarius obscuratus*, *L. omphaliformis* and *Cortinarius helvelloides* was observed (Table 2).

On animal excrements the common species *Ascobolus furfuraceus*, *Cheilymenia stercorea* and *Coprinus stercoreus* were found.

The study on seasonal dynamics of soil fungi and *Actinomycetes* in the hummock and hollow biotopes in the Olszyny Niezgodzkie reserve (Z a b a w s k i et al. 1976) has shown significant quantitative and qualitative differences in distribution of these organisms. The fungi mainly grow on the tops and slopes of the hummocks, while *Actinomycetes* at the foot of the hummocks and in the hollows. The differences in pH values between these sites were significant: at the tops and slopes of the hummocks pH was 3.7, while at the foot of the hummock pH was 5.6, and in the hollows pH was 6.0.

RESULTS AND CONCLUSION

Bog-alder forest is a floristically rich and structurally and ecologically diverse community.

The biotic microforms, the hummocks and hollows, are the sites of occurrence of fungi species, which have different ecological demands. The fungi grow in certain microhabitats and on certain substrates forming separate synusiae.

On the hummocks groups of fungi are distributed on three levels: at the top parts, on the slopes and at the foot (Tables 2 and 3). The horizontal and vertical spatial structure of fungi distribution in the hollows is manifested as a tendency to form groupings of fruit-bodies of certain species at certain specific sites (on particular substrates). These substrates are logs and branches partly submerged in boggy soil, standing dead trees, loose litter and boggy peat soil.

Although in general the fungi response to the two kinds of biotope conditions is similar as that of plants, the distribution of fruit-bodies of the fungi in bog-alder forest is somewhat different than that of vascular and cryptogamous plants. This fact was already indicated by the results of the study in the Białowieża National Park (B u j a k i e w i c z 1994; M u ł e n k o and B u j a k i e w i c z 1996). The vascular plants occur in more or less the same amount on the hummocks and in the hollows, while bryophytes more abundantly on the hummocks. In the bog-alder forests in Białowieża about 70% of the fungi species observed occurred in the hollows.

The study carried out in the Olszyny Niezgodzkie reserve confirms this finding. The majority of fungi, over 70% of the species observed, occur in the hollows, while on the hummocks – about 23%. The instability of the habitat conditions in the hollows induces the fungi to colonise the substrate anew every year or even a few times in a season.

According to the data collected, in the bog-alder forest studied the saprothrophic fungi species dominate and their contribution reaches as much as 90%, the contribution of ectomycorrhizal and parasitic species is relatively insignificant, of about 5% each group.

Fig. 2. High hummocks in the Olszyny Niezgodzkie reserve. Phot. A. Bujakiewicz.

Fig. 3. *Panus tigrinus* grows on logs of black alder submerged in boggy ground. Phot. A. Bujakiewicz.

Fig. 4. *Hymenoscyphus consobrinus* on rotten plant remains. Phot. A. Bujakiewicz.

Fig. 5. *Conocybe rickeniana* occurs in hollows on greasy boggy peat soil. Phot. A. Bujakiewicz.

The observations in the Olszyny Niezgodzkie reserve provided new data on the distribution and ecological demands of many fungi species. The occurrence of *Loweomyces fractipes*, a species very rare in Poland and in Europe, included in the red list as a highly endangered species (Rote Liste 1992, 1996), was noted.

The indicative species of primeval forest *Steccherinum robustius* and *Ganoderma lucidum* were found to occur on alder tree logs (P a r m a s t o 1999).

Other interesting fungi species observed in the alder forests studied were: *Panus tigrinus*, *Mniopetalum globisporum* and *Galerina heimansii*. From the species included in the list of species endangered in Poland (W o j e w o d a and Ł a w r y n o w i c z 1992), the presence of *Stereum subtomentosum* (R), *Antrodiella hoehnelli* (R) and *Calyptella capula* (I) was noted. On the border of the alder forest also the protected species *Phallus impudicus* was found.

The above-discussed results of the study on the occurrence of fungi in the mosaic structure of bog-alder forest are of fragmentary and preliminary character, although throw some light on the ecology and specific distribution of fungi in this interesting forest community.

REFERENCES

A n i o ł - K w i a t k o w s k a J., P e n d e r K. 1997. Plan Ochrony Leśnego Rezerwatu Przyrody „Olszyny Niezgodzkie", Inst. Botaniki Uniwersytetu Wrocławskiego. Wrocław (msc.)

B u j a k i e w i c z A. 1973. Udział grzybów wyższych w lasach łęgowych i olesach Wielkopolski: PTPN, Prace Kom. Biol. 25 (6): 1–91.

B u j a k i e w i c z A. 1985. Macromycetes occurring in floodplain forests near Ithaca, New York, USA. Acta Mycol. 21 (2): 165–192.

B u j a k i e w i c z A. 1994. Macrofungi in the alder forests of the Białowieża National Park. Mycol. Helvetica 6 (2): 57–76.

C z u b i ń s k i Z., G a w ł o w s k a J., Z a b i e r o w s k i K. 1977. Rezerwaty przyrody w Polsce. Studia Naturae Seria B – Wydawn. Popularnonaukowe 27, Zakład Ochrony Przyrody PAN. Kraków–Warszawa.

D o m a ń s k i S. 1955. Z badań nad zgniliznami drewna olszy czarnej (*Alnus glutinosa* L. Gaertn.) w odroślowym drzewostanie w Wesołej koło Siemianic. Acta Soc. Bot. Pol. 24 (2): 287–310.

G r a u w i n k e l B. 1987. Beitrag zur Pilzflora des Erlenbruchwaldes NSG Sodenmatt bei Bremen. Veröff. Überseemus. Bremen (A) 8: 165, Bremen.

H a n s e n L., K n u d s e n H. 1997. Nordic Macromycetes. Vol. 3. Heterobasidioid, Aphyllophoroid and Gasteromycetoid, Basidiomycetes. Nordsvamp. Copenhagen, pp 444.

J a h n H., N e s p i a k A., T ü x e n R. 1967. Pilzsoziologische Untersuchungen in Buchenwäldern des Wesergebirges. Mitt. Flor.-Soz. Arbeitsgem. N.F. 11/12: 159–197.

L i z o ň P. 1992. The genus Hymenoscyphus (Helotiales) in Slovakia, Czechoslovakia. Mycotaxon 45: 1–59.

M a r e k S. 1965. Biologia i stratygrafia torfowisk olszynowych w Polsce. Zesz. Probl. Post. Nauk Roln. 57: 5–264.

M a r e k S. 1970. O ochronie zbiorowisk olszy czarnej. Chrońmy Przyr. Ojcz. 26.

M a t u s z k i e w i c z J. M. 1993. Krajobrazy roślinne i regiony geobotaniczne Polski. Instytut Geografii i Przestrzennego Zagospodarowania PAN, Prace Geograficzne 158. Wrocław, Warszawa, Kraków.

Mułenko W., Bujakiewicz A. 1996. Cryptogamous plants occurring on hummocks in the black alder bog forest (*Carici elongatae-Alnetum*). In: Faliński J. B., Mułenko W. (eds.) Cryptogamous plants in the forest communities of Białowieża National Park. Functional groups analysis and general synthesis (Project CRYPTO 3). Phytocoenosis 8 (N.S.) Archivum Geobotanicum 6. Warszawa–Białowieża: 151–156.

Parmasto E. 1999. Fungi as indicators of primeval forests deserving protection. XIII Congress of European Mycologists, 21–25 September 1999 Book of Abstracts. 102, Alcala de Henares (Madrid) Spain.

Pender K., Anioł-Kwiatkowska J. 1995. Szata roślinna rezerwatu „Olszyny Niezgodzkie". Acta Univers. Wratisl. 1667, Pr. Bot. 62: 159–190.

Rote Liste der gefährdeten Grosspilze in Deutschland. 1992. Naturschutz Special, Deutsch. Gesell. Myk. Bonn.

Rote Liste gefährdeter Pflanzen Deutschlands. 1996. Bundesamt für Naturschutz. Schriftenreihe für Vegetationskunde. 28: 369–376, Bonn–Bad Godesberg.

Solińska-Górnicka B. 1987a. Bagienne lasy olszowe (olsy) w Polsce. Regionalna synteza syntaksonomiczna. Rozprawy Uniwersytetu Warszawskiego 275. Warszawa, pp. 132.

Solińska-Górnicka B. 1987b. Alder (*Alnus glutinosa*) carr in Poland. Tuexenia 7: 329–346.

Szafer W. 1972. Podstawy geobotanicznego Podziału Polski. Szata roślinna Polski niżowej. In: W. Szafer, K. Zarzycki (eds.) Szata roślinna Polski. II. PWN, Warszawa 9–189.

Winterhoff W. 1993. Die Grosspilzflora von Erlenbruchwäldern und deren Kontaktgesellschaften in der nordbadischen Oberrheinebene. Beih. Veröff. Naturschutz Landschaftsplege Bad.-Württ. 74. Karlsruhe: 1–100.

Wojewoda W., Ławrynowicz M. 1992. Red list of threatened macrofungi in Poland. In: K. Zarzycki, W. Wojewoda and Z. Heinrich (eds.) List of threatened plants in Poland (2ed.) PAN, Kraków: 27–56.

Wojterski T., Wojterska H., Wojterska M. 1981. Potencjalna roślinność naturalna dorzecza Baryczy (Mapa 1:200 000) PPWK. Wrocław.

Woś A. 1994. Klimat niziny Wielkopolskiej. Wydawn. Nauk. UAM, Poznań, pp. 192.

Woś A. 1995. Zarys klimatu Polski. Wydawn. Nauk. UAM. Poznań, pp. 301.

Zabawski J., Matuła J., Wojtuń B. 1982. Alarm w sprawie zagrożenia projektowanego rezerwatu olszyn bagiennych w rejonie Niezgody. Chrońmy Przyr. Ojcz. 4–5: 85–89.

Zabawski J., Żurawska M. 1978. Torfowisko olszynowe w dolinie Baryczy i konieczność jego ochrony. Chrońmy Przyr. Ojcz. 1: 25–31.

Zabawski J., Żurawska M., Burzyńska-Czekanowska E. 1976. Study on the flora of Fungi and Actinomycetes in the peat of *Carici elongatae-Alnetum* association. In: Proceedings of the 5th Intern. Peat Congress. New recognitions of peatlands and peat. 2: 142–157. Poznań.

Reakcja macromycetes na mozaikowy układ siedlisk w *Ribo nigri-Alnetum* w rezerwacie Olszyny Niezgodzkie

Streszczenie

Studia mykocenologiczne przeprowadzono w latach 1985–1987 na stałej powierzchni założonej w fitocenozie olsu *Ribo nigri-Alnetum* Sol.-Górn. 1987 w rezerwacie prezentującym unikatowy i modelowy przykład typowej struktury olsu (Ryc. 2).

W odpowiedzi na sprzężony układ funkcjonalny kępy–kotlinki rozmieszczenie grzybów w olsie cechuje pewna regularność w zasiedlaniu mikroform i odpowiednich substratów (Tabela 2 i 3).

W badanym olsie stwierdzono występowanie rzadko w Europie notowanych gatunków np. *Loweomyces fractipes* oraz *Steccherinum robustius*. Są to gatunki nowe dla Polski (Wojewoda, inf. ustna).