Polish Botanical Journal 56(2): 267–285, 2011

MACROFUNGI IN THE *ALNETUM INCANAE* ASSOCIATION ALONG JAWORZYNA AND SKAWICA RIVER VALLEYS (WESTERN CARPATHIANS)

ANNA BUJAKIEWICZ

Abstract. The paper presents the results of mycocoenological studies of six plots in phytocoenoses of a grey alder riparian forest *Alnetum incanae* association in the foothills of the Babia Góra massif, considers the ecological range of various species of macrofungi (e.g. *Rhodocybe ardosiaca*, *Limacella ochraceolutea*, *Ramaria decurrens*), and discusses the habitat preferences of many threatened species (e.g., *Echinoderma jacobi*).

Key words: macrofungi, mycocoenology, grey alder riverine forest, Babia Góra massif, Poland

Anna Bujakiewicz, Department of Plant Ecology and Environmental Protection, Adam Mickiewicz University, Umultowska 89, 61-614 Poznań, Poland; e-mail: ascom@amu.edu.pl

INTRODUCTION

The steep north slope of the Babia Góra massif is covered by many streams and water courses and is drained by the Skawa River and Vistula River into the Baltic Sea. Two main grey alder forest types are encountered as one descends the slopes along streams and rivers. Boggy grey alder forest *Caltho-Alnetum* develops within the lower montane forest zone. Below that zone, for example in the Jaworzyna River valley in Zawoja-Policzne, the riparian forest vegetation begins to change from boggy *Caltho-Alnetum* to mineral *Alnetum incanae* riverside forest. This occurs at *ca* 750 m a.s.l. and continues to the foothills.

Riverside forests, as an azonal vegetation type usually forming narrow strips, are exposed to strong erosion, and are greatly influenced by the adjacent vegetation. They are very important in protecting stream banks and sheltering the river valley against excessive water erosion.

This paper presents data highlighting both the similarities and differences in mycobiota associated with phytocoenoses of the riverine forests occurring on the slopes and foothills of the north slope of the Babia Góra massif. It continues earlier work on the *Caltho-Alnetum* association in this area (Bujakiewicz 2006). Preliminary results of research on the *Alnetum incanae* association in this area were given in a paper comparing the macrofungi growing in boreal and temperate grey alder forests (Bujakiewicz 1993) and in a monograph (Bujakiewicz 2004).

Macrofungi occuring in *Alnetum incanae* forest outside Poland have been the subject of several papers and articles (e.g., Brunner & Horak 1990; Einhellinger 1973; Horak 1985; Griesser 1992).

MATERIAL AND METHODS

This mycocoenological research was done in six permanent observation plots (250–400 m^2 each) laid out mainly in the foothills of the north slope of the Babia Góra massif in the following localities: along Jaworzyna stream near Zawoja-Policzne (ZP I), along the Skawica River in Zawoja (ZC I, ZC II), in Zawoja-Gołynia (ZG) and in Białka (B I, B II) (Fig. 1, Table 2). Phytocoenological relevés in all plots were made by the Braun Blanquet method. Plant nomenclature mostly follows Mirek *et al.* (2002).

In 1987–1999, macrofungi were recorded in phytocoenoses of the *Alnetum incanae* association in August and September (Table 1 & 2), for a total 45 observations.

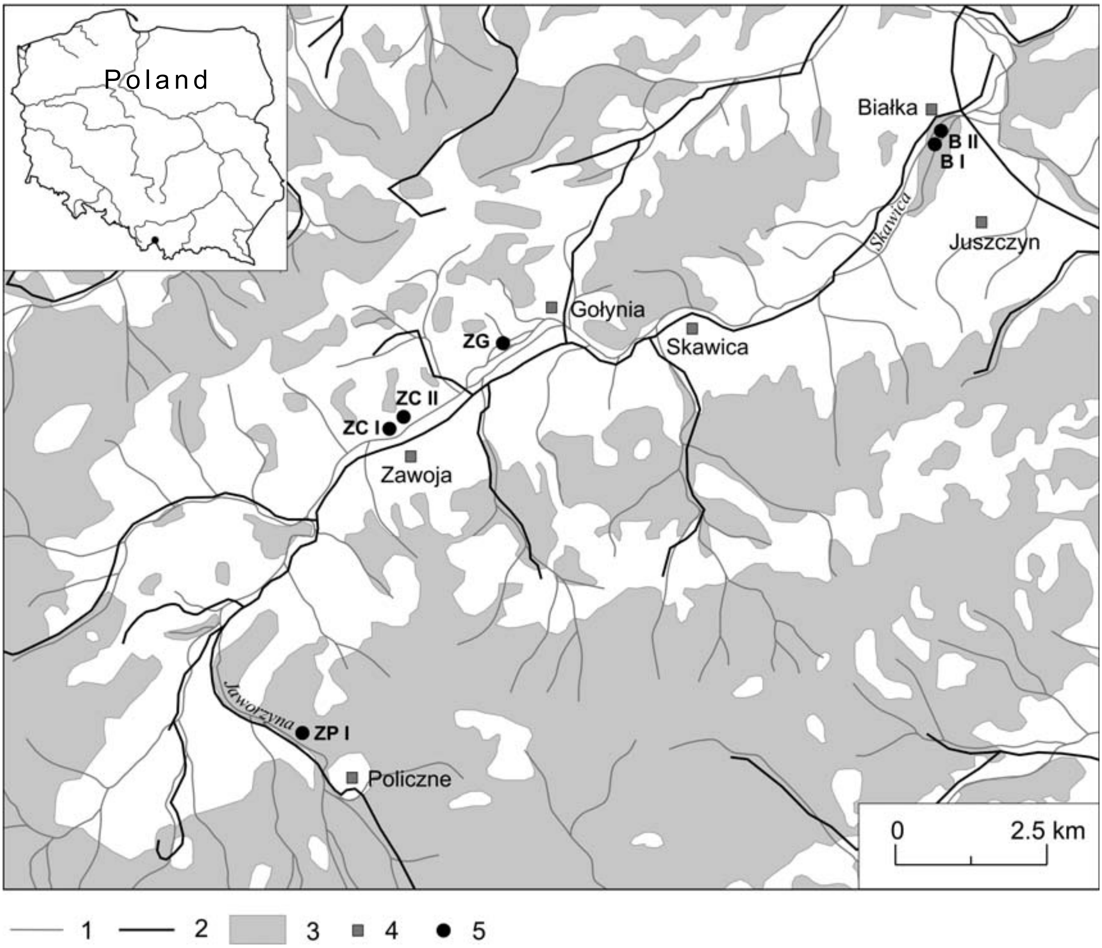

Fig. 1. Zawoja in the foothills of the north slope of the Babia Góra massif. 1 – streams and rivers, 2 – roads, 3 – forests, 4 – larger settlements, 5 – permanent observation plots (after *Pasmo Babiogórskie i Jałowieckie* map, 1:75 000, modified).

Several ecological groups were distinguished in terms of substrate, and trophic groups of macrofungi were delineated. Mycorrhizal macrofungi are assessed mainly according to Trappe (1962) and Kreisel (1987). Table 2 presents the mycocoenological records arranged according to decreasing altitude and gives the temporal frequency and abundance of macrofungi according to the Moser (1949) scale with modifications: 1 corresponds to + and 1, 2a to 2, 2b to 3, and 3 to 4 and 5 (Bujakiewicz 2006). Macrofungi were determined mainly according to recent mycological monographs, and nomenclature generally follows Knudsen and Vesterholt (2008) and Wojewoda (2003).

Mycological documentation is deposited in the Department of Plant Ecology and Environmental Protection of Adam Mickiewicz University, Poznań, Poland (POZM).

Results and discussion

In Poland, *Alnus incana* is a typical montane species that grows along rivers and streams up to 1100 m a.s.l. and extends to the far north of Poland along valleys, descending, for example, down to sea level in the Vistula River valley at Żuławy (Boratyński 1980).

It forms an admixture in various forest associations but as a dominant tree occurs only in the *Alnetum incanae* and *Caltho-Alnetum* associations.

Table 1. *Alnetum incanae* Lüdi 1921 on north slopes of the Babia Góra massif (Western Carpathians)*. LPr – private forest, ZP I – Zawoja-Policzne I, ZC I – Zawoja-Centrum I, ZC II – Zawoja-Centrum II, ZG – Zawoja-Gołynia, B I – Białka I, B II – Białka II.

Number	1	2	3	4	5	6	Constancy
Locality	ZP I	ZC I	ZC II	ZGI	B I	B II	
Exposition	W	–	–	–	–	–	
Altitude (m a.s.l.)	750	540	540	520	480	480	
Mean hight of trees (m)	24	17	22	17	14	18	
Mean diameter of trees (cm)	22	10	18	12	10	14	
Maximal diameter of trees (cm)	42	20	29	22	20	24	
Density of trees a_1 (%)	75	50	75	95	95	90	
Density of trees a_2 (%)	5	75	10	–	–	–	
Density of shrubs b (%)	+	20	30	+	5	25	
Cover of herb layer c (%)	95	95	90	90	95	90	
Cover of moss layer d (%)	30	35	30	30	10	30	
Area of relevé (m^2)	400	350	400	400	400	250	
Number of species	69	62	58	60	52	58	
Property	LPr	LPr	LPr	LPr	LPr	LPr	
Date	6 8 99	5 8 99	5 8 99	4 8 99	4 8 99	4 8 99	
I. Ch.*, D. *Caltho-Alnetum*							
Conocephalum conicum	+.2	.	.	.	.	+	II
* *Caltha laeta*	.	+	.	.	.	.	I
Geum rivale	.	+	.	.	.	.	I
Cardamine amara	.	.	.	.	+	.	I
Myosotis palustris	.	.	.	.	+°	.	I
Rhizomnium punctatum	.	.	.	+°	.	.	I
II. Ch.*, D. *Alnetum incanae*							
* *Alnus incana* a, a_1	4.4	2.2	4.4	5.4	4.4	2.2	V
Alnus incana a_2	1.2	3.4	2.1	.	.	.	III
Alnus incana b	+	2.1	1.2	+	+.2	1.1	V
Alnus incana c	+	+	+	+	.	+	V
Salix fragilis a, a_1	.	2.2	.	1.2	2.2	.	III
Salix fragilis a_2	.	.	+.2	.	.	.	I
Salix fragilis c	.	.	.	.	+.2	.	I
Petasites kablikianus	5.5	3.3	3.4	4.5	3.4	4.4	V
Lamium maculatum	2.2	2.2	2.2	2.2	2.1	.	V
* *Salvia glutinosa*	+.2	+.2	+.2	+.2	.	1.2	V
Orobanche flava	+	1.2	+.2	1.2	+.2	.	V
Chaerophyllum aromaticum	+	+	+.2	+.2	2.1	+	V
Petasites hybridus	.	1.3	1.2	.	2.3	+.2	IV
Primula elatior	1.1	.	+	+.2	r	+.2	V
* *Elymus caninus* (reg.)	.	+	+.2	+.2	1.2	+	V
Geranium phaeum	.	.	.	.	r	.	I
III. Ch. *Alnion incanae*							
Padus avium a	.	1.2	.	+.2	1.2	1.2	IV
Padus avium b	.	.	.	.	+	2.2	II
Padus avium c	.	.	.	.	.	+	I
Viburnum opulus b	.	+.2	.	.	.	.	I
Viburnum opulus c	.	+	.	.	.	.	I
Stachys sylvatica	1.2	1.2	2.2	2.2	+.2	1.2	V
Eurhynchium angustirete	1.2	1.2	1.2	1.2	+.2	2.2	V

Table 1. *Continued.*

Number	1	2	3	4	5	6	C
Impatiens noli-tangere	1.1	1.2	+	.	+	1.2	V
Stellaria nemorum	1.1	1.1	1.2	2.1	2.1	2.1	V
Plagiomnium undulatum	1.2	.	+.2	1.2	+.2	2.2	V
Festuca gigantea	+	+	+	+.2	.	+	V
Chrysosplenium alternifolium	+.2	.	+.2	+.2	+.2	.	IV
Ficaria verna	.	2.2	+	+	.	+	IV
Lysimachia nemorum	+	.	.	.	.	+	II
Rumex sanguineus	.	.	.	.	r	.	I
Astrantia major	.	1.2	.	.	.	.	I
Valeriana sambucifolia	.	+	.	.	.	.	I
Carex remota	.	+	.	.	.	.	I
IV. Ch. *Fagetalia** et *Querco-Fagetea*							
* *Fraxinus excelsior* a, a_1	+	2.1	.	.	.	4.4	III
Fraxinus excelsior a_2	1.2	3.1	+	.	.	.	III
Fraxinus excelsior b	+	1.1	+	+	+	1.1	V
Fraxinus excelsior c	.	+	+	+	1.1	2.1	V
* *Acer pseudoplatanus* a, a_1	.	.	.	.	.	1.1	I
* *Acer pseudoplatanus* a_2	+	1.2	+	.	.	.	III
* *Acer pseudoplatanus* b	+	+	+	+	.	+	V
Acer pseudoplatanus c	r	r	+	.	.	+	IV
Acer platanoides b	.	.	.	+	.	.	I
Tilia platyphyllos a_2	.	+	.	.	.	.	I
Corylus avellana b	.	.	+	.	.	.	I
Lonicera xylosteum b	.	+	.	.	.	.	I
Cerasus avium b	.	+	+	.	.	+	III
Cerasus avium c	.	r	.	.	.	r	II
* *Aegopodium podagraria*	2.1	2.1	3.1	2.1	3.4	3.4	V
* *Ranunculus languinosus*	1.1	1.2	2.1	2.1	+	1.1	V
* *Asarum europaeum*	1.2	.	+.2	+.2	+.2	+.2	V
* *Carex sylvatica*	+	+.2	+	+	r	+.2	V
Poa nemoralis	+	1.2	+.2	+.2	.	+	V
Viola reichenbachiana	+	1.2	+.2	+	.	.	IV
* *Galeobdolon luteum* s.l.	2.1	.	+.2	1.2	.	1.2	IV
* *Campanula trachelium*	.	+	.	+	+	1.1	IV
Ajuga reptans	+	.	+	+	.	+.2	IV
Atrichum undulatum	1.2	.	.	+	+	1.2	IV
Brachypodium sylvaticum	.	.	.	+	.	1.2	II
* *Dentaria glandulosa*	1.1	.	.	.	.	r	II
* *Mercurialis perennis*	2.2	.	.	.	.	.	I
* *Allium ursinum*	2.1	.	.	.	.	.	I
* *Galium odoratum*	+.2	.	.	.	.	.	I
* *Aruncus sylvestris*	r°	.	.	.	.	.	I
* *Symphytum tuberosum*	r	.	.	.	.	.	I
* *Pulmonaria obscura*	+	.	.	.	.	.	I
* *Adoxa moschatellina*	+	.	.	.	.	.	I
* *Dryopteris filix-mas*	+	.	.	.	.	.	I
* *Cerasus avium* a_2	.	1.2	.	.	.	.	I
* *Scrophularia nodosa*	.	+	.	.	.	.	I
* *Euphorbia amygdaloides*	.	.	+	.	.	.	I
V. Ch. *Vaccinio-Piceetea*							
Picea abies a_2	1.1	.	.	.	.	.	I
Picea abies b	+°	.	.	.	.	.	I

Table 1. *Continued.*

Number	1	2	3	4	5	6	C
Abies alba c	r	.	.	.	.	.	I
Dryopteris dilatata	+°	.	.	.	.	+	II
VI. Ch. *Artemisietea**, *Betulo-Adenostyletea*• et *Epilobietea*							
Salix caprea a$_2$	.	.	+	.	.	.	I
Salix caprea b	.	.	+	.	.	.	I
•*Ribes petraeum* b	+	.	.	.	.	.	I
**Urtica dioica*	1.2	1.2	2.3	1.2	1.1	+	V
**Chaerophyllum hirsutum*	1.2	1.2	1.1	2.1	2.2	2.1	V
**Geranium robertianum*	r	+	+	+	r	.	V
Senecio ovatus	+2	1.2	+.2	+.2	.	+	V
**Melandrium rubrum*	+	+	+	+	+.2	+.2	V
**Glechoma hederacea*	.	+	1.2	1.1	1.2	+	V
**Geum urbanum*	.	2.1	2.1	1.1	+.2	+	V
Rubus ideaus	+	+	+	.	.	r	IV
**Moehringia trinervia*	+	.	.	+	+	+	IV
**Galium aparine*	.	1.1	+	1.1	+	.	IV
**Equisetum arvense*	.	+	r	.	r	.	III
**Impatiens parviflora*	.	.	+	+	+	.	III
**Epilobium montanum*	.	.	+	.	.	.	I
**Rumex obtusifolius*	.	.	+	.	.	.	I
Rubus ×corylifolius	.	1.2	.	.	.	.	I
**Galeopsis tetrahit*	r	.	.	.	.	.	I
•*Rumex alpestris*	r	.	.	.	.	.	I
**Anthriscus nitida*	1.2	.	.	.	.	.	I
**Lapsana communis*	r	.	.	.	.	.	I
**Arctium tomentosum*	.	.	.	+	.	.	I
**Cardamine impatiens*	.	.	.	.	r	.	I
Rubus nessensis	.	.	.	.	.	+°	I
VII. Ch. *Molinio-Arrhenatheretea*							
Heracleum sphondylium	+°	r	+	.	+	.	IV
Angelica sylvestris	r	+	+	+	.	.	IV
Lysimachia nummularia	.	3.2	.	1.1	+.2	.	III
Poa trivialis	.	.	.	+.2	2.2	1.2	III
Cardamine pratensis	r	.	.	+	+°	.	III
Dactylis glomerata	.	.	+°	.	.	+°	II
Deschampsia caespitosa	.	+	.	+°	.	1.2	III
Filipendula ulmaria	+°	2.1	.	.	.	r	III
Ranunculus repens	.	+	+	.	.	.	II
Taraxacum officinale agg.	.	.	.	r°	.	.	I
Mentha longifolia	.	.	.	.	+.2	.	I
VIII. Other							
Salix ×rubens a	.	.	.	.	1.2	.	I
Salix ×rubens b	.	.	.	.	+	.	I
Salix purpurea b	.	+.2	.	.	+.2	.	II
Sambucus nigra b	.	+.2	3.3	.	+	1.2	IV
Sambucus nigra c	.	.	+	.	r	+	III
Crataegus rhipidophylla b	.	.	.	.	.	+	I
Sorbus aucuparia b	.	+	+	.	.	.	II
Sorbus aucuparia c	.	.	r	.	.	.	I
Cirriphyllum piliferum	1.2	+.2	+	+	+.2	1.2	V
Eurhynchium hians	1.2	2.3	2.2	1.2	2.2	1.2	V

Table 1. *Continued.*

Number	1	2	3	4	5	6	C
Brachythecium rutabulum	1.2	1.2	2.2	2.2	+.2	.	V
Fissidens taxifolius	+.2	2.2	+.2	1.2	+	+	V
Athyrium filix-femina	+	+	+	.	+°	+.2	V
Oxalis acetosella	+.2	.	.	+.2	.	2.2	III
Calliergonella cuspidata	.	+.2	.	+	.	+.2	III
Plagiomnium cuspidatum	+	.	.	.	+	+.2	III
Plagiothecium nemorale	+.2	.	.	+	.	+	III
Plagiomnium ellipticum	+	.	.	+	.	+.2	III
Brachythecium populeum	+.2	.	1.2	+.2	.	.	III
Lophocolea bidentata	.	.	.	+	.	r	II
Dryopteris carthusiana	.	.	.	+	.	+°	II
Plagiochila asplenioides	+	.	.	.	.	+	II
Plagiomnium affine	.	.	+	.	.	.	I
Plagiothecium cavifolium	+.2	.	.	.	.	.	I
Lycopus europaeus	.	1.2	.	.	.	.	I
Brachythecium salebrosum	.	+.2	.	.	.	.	I

* – phytosociological relevés made by Andrzej Brzeg

The habitat of the *Alnetum incanae* association differs significantly from that of the *Caltho-Alnetum* association. The former develops on gravelly and stony river banks on initial mountain soils which are humose, have neutral (or slightly acidic) reaction and are biologically active (Wojterski 1980).

On the north slope of Babia Góra massif the *Alnetum incanae* association occurs mostly in the foothills, but some phytocoenoses are found within the lower montane zone at 750 m a.s.l. (ZP I) (Table 1).

The studied phytocoenoses are very rich floristically (average 60 species per relevé) and are dominated by grey alder (*Alnus incana*), which occurs with spruce (*Picea abies*) at higher elevations and willow (*Salix fragilis*), ash (*Fraxinus excelsior*) and sycamore maple (*Acer pseudoplatanus*) in the foothills (Table 1). The characteristic species are *Salvia glutinosa* and *Elymus caninus*. Many species of the *Alnion incanae* alliance play a significant role by forming a lush field layer with *Petasites kablikianus*, *Lamium maculatum*, *Stachys sylvatica* and *Stellaria nemorum* and a constant moss layer with *Plagiomnium undulatum* and *Eurhynchium angustirete* (Table 1).

The arrangement of the six studied localities roughly forms an altitudinal transect starting from 750 m a.s.l. (ZP I) and ending at 480 m a.s.l. (B I, II). Zarzycki (1956) stressed the habitat and floristic differences in *Alnetum incanae* located below and above 600 m a.s.l. Those differences could be observed in the studied localities.

The first permanent plot (ZP I), located at 750 m a.s.l., has fine-grained clayey soils and is surrounded by the *Dentario glandulosae-Fagetum* ass. It is distinguished by beech montane species (*Allium ursinum*, *Dentaria glandulosa*, *Galium odoratum*, *Mercurialis perennis*) and has an admixture of *Picea abies* and *Abies alba*. Genus *Salix* is not present in that permanent plot.

The next two permanent plots (ZC I, II) have stony ground and are significantly affected by grazing. Grazing and other human activities (e.g., construction) are more intense at the lower elevations and are noted in all discussed localities. Several nitrophilous species grow here, representing the classes *Artemisietea* (*Epilobium montanum*, *Equisetum arvense*, *Galium aparine*, *Rumex obtusifolius*) and *Molinio-Arrhenatheretea* (*Lysimachia nummularia*, *Ranunculus repens*). Species of the *Alnion incanae* alliance (*Ficaria verna*, *Astrantia major*) grow here, and also some representatives of the order *Fagetalia* (*Cerasus avium*, *Tilia platyphyllos*) (Table 1).

The permanent plot in Zawoja-Gołynia (ZG) has typical features of *Alnetum incanae* and develops on gravel and deposited silt.

In Białka (B I) the phytocoenosis of the *Alnetum incanae* ass. is very close to the main course of the Skawica River and represents an initial stage on young alluvial deposits.

The plot in Białka II (B II) is far (*ca* 300 m) from the main course of the river. It represents a mature stage of *Alnetum incanae*, with admixture of *Acer pseudoplatanus* and *Fraxinus excelsior*. It shows some small evidence of flooding.

Flooding is a constant feature of the *Alnetum incanae* forest type. It occurs almost every year in spring and/or summer at varying intensity but causes large changes, destruction and accumulation of debris and waste. During the observation period there was a strong drought in 1992; the strongest flooding was in 1991, 1995 and 1997.

The dense riverine *Alnetum incanae* forests are very diverse in vegetation and in mycobiota (Tables 1 and 2). In the lower course of the Skawica River (*ca* 480 m a.s.l.) it has a rather close affinity to the surrounding *Tilio-Carpinetum* forest. The upper course of the Jaworzyna River (*ca* 750 m a.s.l.) is linked with the lower montane beech forest *Dentario glandulosae-Fagetum* association.

Several dominant trees of *Alnetum incanae* – *Alnus*, *Salix* and *Picea* – are rich in ectomycorrhizal associates; others such as *Acer* or *Fraxinus* have endomycorrhizal connections only.

Flooding and the diversity of ground substrate types, with sandy clayey, gravelly and stony soil, offers different and constantly changing conditions for the development of fungus fruitbodies.

The group of fungi forming their carpophores on the ground consists of ectomycorrhizal species (31 taxa, 10%) and terricolous saprobic fungi (79 species, 27%) (Table 2).

The most characteristic and constant macrofungi growing in phytocoenoses of *Alnetum incanae* represent the ectomycorrhizal trophic group connected with *Alnus incana*: *Lactarius obscuratus*, *Paxillus filamentosus*, *Naucoria scolecina*, *Lactarius omphaliformis*, *Russula alnetorum*, *Cortinarius helvelloides* and *Naucoria escharioides* (Table 2).

Interesting is the occurrence of representatives of the genus *Inocybe* (7 species), mostly *I. calospora*, *I. cincinnata* and *I. fuscidula*. Aside from *I. calospora* they show a broad ecological amplitude (Kreisel 1987; Stangl 1989; Breitenbach & Kränzlin 2000). Other species of this genus (e.g., *I. alnea*, *I. curvipes*, *I. lutescens*) were encountered in only one locality (Table 2) and seem to be associated with *Salix* spp.

Strict alder associates such as *Cortinarius alnetorum*, *C. americanus*, *Lactarius lilacinus*, *Naucoria celluloderma*, *N. luteolofibrillosa*, *N. striatula* and *N. subconspersa* were also recorded only occasionally in one or two localities.

Similarly scattered and not abundant were the well known ectomycorrhizal associates of alder and/or other tree species (e.g., *Laccaria laccata*, *L. tortilis*, *Hebeloma gigaspermum*, *H. sacchariolens*, *Entoloma rhodopolium*, *Lactarius glyciosmus*, *Cortinarius torvus*).

Terricolous saprobic fungi grow numerously in *Alnetum incanae*. The dominant group is composed of *Cystolepiota seminuda*, *Pholiotina filaris*, *Echinoderma jacobi* (Fig. 2), *Entoloma dysthaloides*, *E. pleopodium* (Fig. 3), *Conocybe microspora*, *Cystolepiota hetieri*, *Limacella ochraceolutea* (Fig. 4) and *Lepiota cristata*. They are mostly basiphilous and/or nitrophilous species forming rather small, ephemeral basidiocarps directly on naked humose soil. This group is formed also by *Conocybe moseri*, *Coprinopsis cortinatus*, *Lepiota boudieri* and *Pholiotina brunnea*, showing less abundant fructification.

The composition of assemblages of these specific humicolous fungi resembles the synusia-like grouping called *Pholiotina mairei* – *Entoloma pleopodium* recently provisionally distinguished in carr forests of the *Alnion incanae* alliance (Bujakiewicz 2010). Half of the described representatives of this grouping occur in the discussed *Alnetum incanae* association. The most complete assemblages were observed at localities VI, VII, IX and XI (Table 2), and the mass occurrence of two ascomycetous terrestrial taxa, *Cheilymenia vitellina* and *Peziza celtica*, was noted at localities VII and IX.

The appearance of *Rhodocybe ardosiaca* at Białka (locality X and XI) deserves attention. The

Table 2. Macrofungi recorded in the *Alnetum incanae* association along the Jaworzyna River and Skawica River valleys (Western Carpathians). Trophic groups: M – ectomycorrhizal (e.g., Trappe 1962; Kreisel 1987), P – parasitic, S – saprotrophic. First figure in column (1–10) is the number of records of the species in the plot (temporal frequency). Second figure gives the degree of abundance. Study plots: ZP I – Zawoja-Policzne I, ZC I – Zawoja-Centrum I, ZC II – Zawoja-Centrum II, ZG – Zawoja-Gołynia, B I – Białka I, B II – Białka II.

	Trophic group	Number						Constancy
		1	2	3	4	5	6	
Locality		ZPI	ZC I	ZC II	ZG	B I	B II	
Number of plot		VI	VII	VIII	IX	X	XI	
Number of observations		14	11	4	4	7	5	
Number of species		139	131	41	92	93	66	
ON GROUND								
** *Lactarius lilacinus* (Lasch) Fr.	M	7^{2a-3}						I
** *Naucoria luteolofibrillosa* (Kühner) Pilát	M	2^{2b-3}						I
** *Naucoria subconspersa* P. D. Orton	M	2^{2b-3}						I
* *Naucoria striatula* P. D. Orton	M	2^{1-3}						I
Conocybe subpallida Enderle	S	2^{1}						I
Macrocystidia cucumis (Pers.: Fr.) Joss.	S	2^{1}						I
Omphalina pyxidata (Bull.: Fr.) Quél.	S	1^{2b}						I
Clavulina coralloides (L.: Fr.) J. Schröt.	M	1^{2a}						I
Chlorophyllum rachodes (Vittad.) Vellinga	S	1^{1}						I
Conocybe ambigua Watling	S	1^{1}						I
Conocybe echinata (Velen.) Singer	S	1^{1}						I
Conocybe exannulata (Kühner & Watling) Courtec.	S	1^{1}						I
Conocybe juniana (Velen.) Hauskn. & Svrček	S	1^{1}						I
Conocybe pubescens (Gillet) Kühner	S	1^{1}						I
* *Cortinarius alnetorum* (Velen.) M. M. Moser	M	1^{1}						I
Entoloma scabrosum (Fr.) Noordel.	S	1^{1}						I
* *Naucoria celluloderma* P. D. Orton	M	1^{1}						I
Paxillus involutus (Batsch: Fr.) Fr.	M	1^{1}						I
Peziza howsei (Boud.) Donadini	S	1^{1}						I
Peziza succosa Berk.	S	1^{1}						I
Rugosomyces carneus (Bull.: Fr.) Bon	S	1^{1}						I
Lepiota boudieri Bres.	S	1^{1}	1^{2a}					II
Lactarius omphaliformis Romagn.	M	5^{1-3}	2^{1}	1^{1}	1^{2a}			IV
** *Naucoria escharioides* (Fr.: Fr.) P. Kumm.	M	4^{1-3}	1^{2a}	1^{2a}				III
Rhodocybe nitellina (Fr.) Singer	S	3^{1-2a}	1^{1}	1^{1}				III
Naucoria scolecina (Fr.) Quél.	M	2^{1-2a}	3^{2a-2b}		1^{2b}	2^{1}		IV
** *Paxillus filamentosus* (Scop.) Fr.	M	9^{1-3}	4^{1-2a}			3^{1-2a}	$1^{(1)}$	IV
* *Russula alnetorum* Romagn.	M	8^{1-3}	3^{1-2a}	2^{1}	2^{1}			IV
Tarzetta cupularis (L.: Fr.) Lambotte	S	4^{1-2a}	3^{1-3}	1^{2a}	1^{2a}	2^{1-2a}		V
Entoloma dysthaloides Noordel.	S	2^{1}	6^{1-2a}		2^{1}		$2^{1(1)}$	IV
* *Lactarius obscuratus* (Lasch) Fr.	M	11^{1-3}	7^{1-3}	3^{1-2a}	2^{1-2a}	1^{1}	$2^{1[1]}$	V
Ascobolus viridis Curr.	S	1^{1}	1^{1}		1^{1}			III
Conocybe moseri Watling	S	1^{1}				1^{1}		II
Pholiotina brunnea (Watling) Singer	S	1^{1}				1^{1}		II
Conocybe microspora (Velen.) Dennis var. *microspora*	S	1^{1}			1^{1}	2^{1}		III
Entoloma tibiicystidiatum Arnolds & Noordel.	S	1^{1}			1^{1}		2^{1}	III
Entoloma rhodopolium (Fr.) P. Kumm.	M		3^{1-2a}					I

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
Agaricus arvensis Schaeff.	S		1^{1}					I
Entoloma cf. *lepiotosme* (Romagn.) Noordel.	S		1^{1}					I
Hebeloma gigaspermum Gröger & Zschiesch	M		1^{1}					I
Lepiota castanea Quél.	S		1^{1}					I
Lepiota fuscovinacea F. H. Møller & J. E. Lange	S		1^{1}					I
Melanoleuca polioleuca (Fr.: Fr.) Kühner & Maire f. *langei* Boekhout	S		1^{1}					I
Mycena niveipes (Murill) Murill	S		1^{1}					I
Pholiotina sulcata Arnolds & Hauskn.	S		1^{1}					I
Pseudoomphalina cf. *kalchbrenneri* (Bres.) Singer	S		1^{1}					I
Cheilymenia vitellina (Pers.: Fr.) Dennis	S		2^{1-3}		1^{2a}			II
Limacella glioderma (Fr.) Maire	S		1^{2b}	1^{1}				II
Coprinopsis atramentaria (Bull.: Fr.) Redhead	S		1^{2a}			1^{1}		II
Peziza celtica (Boud.) M. M. Moser	S		1^{2a}		2^{1-3}			II
Cystolepiota hetieri (Boud.) Singer	S		5^{1-2b}	1^{1}	2^{2b-3}			III
Limacella ochraceolutea P. D. Orton	S		3^{1-2a}	2^{1-2a}	1^{1}			III
Echinoderma jacobi (Vellinga & Knudsen) Gminder	S		7^{1-3}	3^{1}	3^{1-3}		$1^{(1)}$	IV
Lycoperdon molle Pers.	S		6^{1-3}		2^{2a-3}	2^{2a}		III
+ *Cystolepiota seminuda* (Lasch) Bon	S		4^{1-2b}	1^{1}	2^{1}	3^{1-2b}	$2^{1[1]}$	V
Pholiotina filaris (Fr.) Singer	S		4^{1}	1^{1}	3^{1}	1^{1}	$2^{1(1)}$	V
Inocybe cincinnata (Fr.: Fr.) Quél. var. *cincinnata*	M		3^{1-2a}	1^{1}	1^{1}	2^{1-3}		IV
Inocybe calospora Quél.	M		2^{1-2a}	1^{1}	1^{1}	2^{1}	$1^{[1]}$	V
* *Cortinarius helvelloides* (Fr.: Fr.) Fr.	M		1^{2b}		1^{1}	1^{1}		III
Entoloma pleopodium (Bull.: Fr.) Noordel	S		1^{1}		1^{1}	3^{1-2a}	1^{1}	IV
+ *Lepiota cristata* (Bolton: Fr.) P. Kumm.	S		1^{1}			3^{1-3}	$1^{(1)}$	III
Inocybe fuscidula Velen. var. *fuscidula*	M		1^{1}		3^{1}	2^{1-3}	4^{1-2a}	IV
Lepista irina (Fr.) H. E. Bigelow	S			1^{1}				I
Pseudoclitocybe cyathiformis (Bull.: Fr.) Singer	S			1^{1}				I
Coprinopsis lagopus (Fr.: Fr.) Redhead, Vilgalys & Moncalvo	S			1^{1}			$1^{[1]}$	II
Entoloma politum (Pers.: Fr.) Donk	S			1^{1}			1^{1}	II
Psathyrella obtusata (Pers.: Fr.) A. H. Sm.	S				2^{1-2b}			I
Psathyrella canoceps (Kauffman) A.H. Sm.	S				2^{2a}			I
Humaria hemisphaerica (F. H. Wigg.: Fr.) Fuckel	M				1^{3}			I
Pholiotina rugosa (Peck) Singer	S				1^{2a}			I
Bovista paludosa Lév.	S				1^{1}			I
Conocybe tenera (Schaeff.: Fr.) Fayod	S				1^{1}			I
Flammulaster cf. *ferrugineus* (Maire) Watling	S				1^{1}			I
Helvella macropus (Pers.: Fr.) P. Karst.	S				1^{1}			I
Inocybe lutescens Vel.	M				1^{1}			I
Lactarius glyciosmus (Fr.: Fr.) Fr.	M				1^{1}			I
Panaeolus papilionaceus (Bull.: Fr.) Quél.	S				1^{1}			I
Tarzetta cf. *spurcata* (Pers.) Harmaja	S				2^{1}	3^{1-3}		II
Cortinarius torvus (Fr.: Fr.) Fr.	M				2^{1-2a}	2^{1-2b}		II
Helvella elastica Bull.	S				1^{2a}	1^{1}		II
Laccaria tortilis (Bolton) Cooke	M				1^{1}	2^{1-2a}	3^{1-2a}	III
* *Rhodocybe ardosiaca* Horak & Grieser	S					3^{1}	$1^{[1]}$	II
Melanophyllum haematospermum (Bull.: Fr.) Kreisel	S					4^{1-3}		I

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
* *Inocybe alnea* Stangl	M					2^{1}		I
Melanoleuca arcuata (Bres.) Bon	S					2^{1}		I
Peziza arvernensis Boud.	S					2^{1}		I
Peziza limosa Grelet & Nannf.	S					1^{3}		I
Agaricus sylvaticus Schaeff.: Fr.	S					1^{2a}		I
Cystolepiota adulterina (F. H. Møller) Bon	S					1^{2a}		I
Hebeloma sacchariolens Quél.	M					1^{2a}		I
Scutellinia crucipila (Cooke & Phill. in Cooke) J. Mor.	S					1^{2a}		I
Conocybe pilosella (Pers.: Fr.) Kühner	S					1^{1}		I
Coprinopsis cortinatus J. E. Lange	S					1^{1}		I
Coprinus comatus (O. F. Müll.: Fr.) Pers.	S					1^{1}		I
Lycoperdon perlatum Pers.: Pers.	S					1^{1}		I
Lycoperdon umbrinum Pers.: Pers.	S					1^{1}		I
Agrocybe arvalis (Fr.: Fr.) R. Heim & Romagn.	S					1^{1}	1^{1}	II
Inocybe cf. *ochroalba* Bruylants	M					1^{2a}	2^{1-2a}	II
Phallus impudicus L.: Pers.	S					1^{1}	2^{1}	II
Entoloma sodale Noordel.	S						2^{1}	I
Lepiota cf. *hymenoderma* D. A. Read	S						2^{1}	I
* *Cortinarius americanus* A. H. Sm. (*C. bibulus* Quél.)	M						1^{3}	I
Agrocybe erebia (Fr.: Fr.) Singer	S						1^{1}	I
Hygrocybe vitellina (Fr.) P. Karst.	S						1^{1}	I
Inocybe curvipes P. Karst.	M						1^{1}	I
+ *Laccaria laccata* (Scop.: Fr.) Berk. & Broome	M						1^{1}	I
Tubaria dispersa (Pers.) Singer	S						1^{1}	I
Peziza cf. *limnaea* Maas Geest.	S						$1^{[1]}$	I
Psathyrella prona (Fr.) Gillet	S						$1^{(2a)}$	I
ON LITTER								
+ *Mycena epipterygia* (Scop.: Fr.) Gray var. *epipterygia*	S	2^{1}						I
Stropharia aeruginosa (Curtis: Fr.) Quél.	S	2^{1}						I
Mycena pterigena (Fr.: Fr.) P. Kumm.	S	1^{2b}						I
Entoloma cephalotrichum (P. D. Orton) Noordel.	S	1^{2a}						I
Clitocybe cf. *langei* Sing *ex* Hora[4]	S	1^{1}						I
Marasmius bouillardii Quél.	S	1^{1}						I
Pholiotina arrhenii (Fr.) Singer.	S	1^{1}						I
Entoloma juncinum (Kühner & Romagn.) Noordel.	S	6^{1-2a}	1^{1}					II
Stropholoma squamosa (Pers.: Fr.) Ryman	S	3^{1-2a}	1^{2b}					II
Mycena flavoalba (Fr.) Quél.	S	1^{1}	1^{1}					II
Clitocybe cf. *brumalis* (Fr.: Fr.) Kummer[4]	S	1^{1}	1^{2a}					I
Ramaria decurrens (Pers.) R. H. Petersen	S	1^{1}	1^{2a}					II
* *Phaeomarasmius erinaceus* (Fr.) Kühner	S	1^{1}	2^{1-2a}					II
Psathyrella noli-tangere (Fr.) A. Pearson & Dennis	S	1^{1}	1^{1}					II
Psathyrella cernua (Vahl: Fr.) G. Hirsch	S	1^{1}		1^{1}				II
Mycena leptocephala (Pers.) Gillet	S	5^{1}	5^{1-2a}		1^{1}	1^{1}		IV
Mycena galopus (Pers.: Fr.) P. Kumm.	S	4^{1-2a}	1^{1}		1^{1}			III
Clitocybe fragrans (With.: Fr.) P. Kumm.	S	3^{1-2a}	3^{1-2b}				$1^{[1]}$	III
Gymnopus confluens (Pers.: Fr.) Antonin	S	10^{2a-3}	7^{1-3}		2^{2a-2b}	3^{2a-2b}		IV
Cyathus striatus (Huds.) Willd.: Pers.	S	8^{1-2a}	3^{1-2a}		3^{2a-2b}	5^{1-2b}	1^{2b}	V

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
+ *Mycena pura* (Pers.: Fr.) Kumm.	S	7^{1-2a}	6^{1-2a}		1^{1}	1^{1}	3^{1}	V
+ *Psathyrella candolleana* (Fr.: Fr.) Maire	S	4^{1-3}	5^{1-2a}	1^{1}	2^{1-3}	5^{1-3}		V
+ *Mycena speirea* (Fr.: Fr.) Gillet	S	4^{1}	8^{1-2b}	1^{2a}	3^{1-2a}	6^{1-2b}	$3^{1(1)}$	V
Marasmius rotula (Scop.: Fr.) Fr.	S	3^{1-3}	9^{1-3}	3^{1-2a}	4^{1-2b}	4^{1-2b}	4^{2a-3}	V
Irpex ochraceus (Pers.: Fr.) Kotiranta & Saarenoksa	S	3^{1-2b}		2^{1}	1^{1}	1^{1}	3^{1}	V
Marasmius torquescens Quél.	S	2^{1-2a}				3^{1-2b}	2^{1-2a}	III
Tubaria furfuracea (Pers.: Fr.) Gillet	S	2^{1-2a}	1^{2a}	1^{1}		1^{1}		IV
+ *Mycena acicula* (Schaeff.) P. Kumm.	S	2^{1}	2^{1}		1^{1}	2^{1}		IV
Marasmiellus vaillantii (Pers.: Fr.) Singer	S	1^{2a}	6^{2a-2b}	2^{1-2b}	3^{2a-1}	4^{1-3}		V
Gymnopus peronatus (Bolton: Fr.) Antonin	S	2^{1-2a}	1^{2a}				1^{1}	III
Byssomerulius corium (Pers.: Fr.) Parmasto[1]	S	1^{1}	4^{1-2b}		2^{1-2a}	4^{1-2a}	$3^{1(1)}$	V
Hymenoscyphus calyculus (Sowerly: Fr.) W. Phillips	S	1^{1}	3^{1-3}	1^{1}				III
Crepidotus variabilis (Pers.: Fr.) P. Kumm.	S		1^{2}					I
Coprinellus xanthothrix (Romagn.) Vilgalys	S		1^{1}					I
Encoelia cf. *fascicularis* (Alb. & Schwein.) P. Karst.	S		1^{1}					I
Gymnopus dryophilus (Bull.: Fr.) Murill	S		1^{1}					I
Simocybe haustellaris (Fr.: Fr.) Watling	S		1^{1}					I
Sphaerobolus stellatus Tode: Pers.	S		1^{1}					I
Stereum cf. *complicatum* (Fr.) Fr.	S		1^{1}					I
Typhula villosa (Schum.: Fr.) Fr.[1]	S		1^{1}					I
Clitocybe nebularis (Batsch.: Fr.) P. Kumm.	S		1^{1}	1^{1}				II
Crepidotus luteolus (Lambotte) Sacc.	S		1^{2a}	1^{2b}		1^{1}		III
Mycena vitilis (Fr.) Quél.	S		2^{1-2a}		2^{1}			II
Molissia melaleuca (Fr.: Fr.) Sacc.	S		1^{1}		1^{1}			II
+ *Coprinellus domesticus* (Bolton: Fr.) Vilgalys	S		2^{1}		1^{1}	1^{1}	1^{1}	IV
Calvatia excipuliformis (Scop.: Pers.) Perdeck	S		1^{1}		1^{2a}	2^{1}	1^{1}	IV
Hymenoscyphus albidus (Roberge *ex* Desm.) W. Phillips	S		1^{3}			1^{3}		II
Mycena filopes (Bull.: Fr.) P. Kumm.	S			1^{1}	3^{1}	1^{2a}		III
Clitocybe vibecina (Fr.) Quél.[4]	S				1^{1}			I
Gymnopus aquosus (Bull.: Fr.) Antonin & Noordel.	S				1^{1}			I
Marasmius wynnei Berk. & Broome	S				1^{1}			I
Psathyrella orbitarum (Romagn.) M. M. Moser	S				$1^{(3)}$	1^{2a}		II
Stropharia pseudocyanea (Desm.: Fr.) Morgan	S					1^{2b}		I
Agrocybe firma (Peck) Singer	S					1^{1}		I
Hymenoscyphus caudatus (P. Karst.) Dennis	S					1^{1}		I
Irpex cf. *lactaeus* (Fr.: Fr.) Fr.	S					1^{1}		I
Stropharia rugosoannulata Murill	S					1^{1}		I
* *Pezizella alniella* (Nyl.) Dennis	S	1^{1}						I
Mycena stylobates (Pers.: Fr.) P. Kumm.	S	2^{1}	1^{1}					II
Molissia amenticola (Sacc.) Rehm	S		1^{2a}					I
Xylaria carpophila (Persoon) Fries	S				1^{1}			I
Hymenoscyphus fructigenus (Bull.) Fr.	S					1^{1}		I
Hemimycena pseudocrispula (Kühner) Singer	S	10^{1-3}			1^{1}	3^{1-2b}		III
Crocicreas coronatum (Bull.) S. E. Carp.	S	1^{2a}	1^{1}			1^{3}		III
Calyptella capula (Holmsk.: Fr.) Quél.	S	6^{1-3}	4^{1-2b}	1^{3}	2^{2a-3}	3^{1-3}		V
Typhula uncialis (Grev.) Berthier	S	8^{3}	5^{1-3}	2^{1-3}	2^{1}	4^{2b-3}	$2^{(2a)2b}$	V

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
Hymenoscyphus scutula (Pers.: Fr.) W. Philips	S		5^{2a-3}			1^{3}		II
Crepidotus epibryus (Fr.: Fr.) Quél.	S						1^{1}	I
ON WOOD								
Calocera viscosa (Pers.: Fr.) Fr.	S	4^{1}						I
Ciboria dumbirensis (Velen.) Spooner	S	3^{1-2a}						I
Pseudohydnum gelatinosum (Scop.: Fr.) P. Karst.	S	3^{1}						I
Hymenoscyphus imberbis (Bull.: Fr.) Dennis	S	2^{1-2a}						I
Antrodia heteromorpha (Fr.: Fr.) Donk[1]	S	2^{1}						I
Galerina marginata (Batsch) Kühner	S	2^{1}						I
Gerronema xanthophyllum (Bres.) Norvell.	S	2^{1}						I
Megacollybia platyphylla (Pers.: Fr.) Kotl. & Pouzar	S	2^{1}						I
Polyporus arcularius (Batsch) Fr.	S	2^{1}						I
Crepidotus mollis (Schaeff.: Fr.) Staude	S	1^{2a}						I
Lasiosphaeria spermoides Ces. & de Not.[2]	S	1^{2a}						I
Lentaria subcaulescens (Rebent.) Rauschert[1]	S	1^{2a}						I
Amylostereum areolatum (Chaillet: Fr.) Boidin[1]	S	1^{1}						I
Calocera cornea (Batsch: Fr.) Fr.	S	1^{1}						I
Ganoderma applanatum (Pers.) Pat.	P/S	1^{1}						I
Gloeophyllum odoratum (Wulf.: Fr.) Imaz.	S	1^{1}						I
Hohenbuehelia fluxilis (Fr.: Fr.) P. D. Orton	S	1^{1}						I
Oligoporus alni (Niemelä & Vampola) M. Piątek[1]	S	1^{1}						I
Oligoporus caesius (Schrad.: Fr.) Gilbertson & Ryvarden	S	1^{1}						I
+ *Phlebia radiata* Fr.[1]	S	1^{1}						I
Phlebia tremellosa (Schrad.: Fr.) Nakasone & Burds.	S	1^{1}						I
Pholiota scamba (Fr.: Fr.) M. M. Moser	S	1^{1}						I
+ *Polyporus ciliatus* Fr.: Fr.	S	1^{1}						I
Pycnoporus cinnabarinus (Jacq.: Fr.) P. Karst.	S	1^{1}						I
Scutellinia setosa (Nees: Fr.) Kuntze	S	1^{1}						I
Mycetinis alliaceus (Jacq.: Fr.) Earle	S	6^{1-2a}	1^{1}					II
Stereum rugosum (Pers.: Fr.) Fr.[1]	S	9^{1-2a}	2^{1}			1^{2a}		III
Lentinellus flabelliformis (Bolton: Fr.) S. Ito	S	4^{1}	2^{1-2a}					II
* *Hypoxylon fuscum* (Pers.) Fr.[2]	S	3^{1-2a}	1^{2b}					II
* *Peniophora ericksonii* Boidin[1]	S	3^{1-2a}			1^{1}			II
Ascocoryne cylichnium (Tul.) Korf.	S	2^{1-2a}	1^{2a}					II
Hypholoma lateritium (Schaeff.: Fr.) P. Kumm.	S	2^{1}	1^{1}					II
Bisporella citrina (Batsch: Fr.) Korf. & S. E. Carp.	S	1^{1}	1^{1}					II
Fomes fomentarius (L.: Fr.) Kicks	P/S	1^{1}	1^{1}					II
Hyphoderma setigerum (Fr.) Donk[1]	S	1^{2a}	1^{2a}					II
Peniophora incarnata (Pers.: Fr.) P. Karst.	S	1^{1}	1^{2a}					II
Panellus stipticus (Bull.: Fr.) P. Karst.	S	2^{1}			1^{1}			II
Gymnopilus penetrans (Fr.) Murill	S	2^{1}					$1^{(1)}$	II
+ *Fomitopsis pinicola* (Swartz.: Fr.) P. Karst.	P/S	5^{1-2a}			1^{1}			II
Xylaria hypoxylon (Linnaeus) Greville	S	5^{1}	4^{1}		2^{2a}			III
Kuehneromyces mutabilis (Schaeff.: Fr.) Singer & A. H. Smith	S	1^{2a}	1^{1}		1^{2a}			III
Schizophyllum commune Fr.: Fr.	S	1^{2a}				1^{1}		II

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
+ *Polyporus varius* (Pers.): Fr.	S	1^{1}	1^{2}	1^{1}	1^{1}			IV
* *Eutypella cerviculata* (Fr.: Fr.) Sacc.[2]	S	4^{1-3}	3^{1-3}	1^{1}	1^{1}			IV
Hyphodontia paradoxa (Schrad.: Fr.) E. Langer & Vesterholt[1]	S	8^{1-2b}	6^{1-3}	1^{1}	3^{1}	1^{1}	2^{1}	V
+ *Mycena haematopus* (Pers.: Fr.) P. Kumm.	S	6^{1}	1^{2a}		1^{2a}	1^{1}	4^{1-2a}	V
+ *Mycena galericulata* (Scop.: Fr.) S. F. Gray	S	5^{1-2b}	7^{1-2b}		3^{1-2b}	1^{1}	$2^{1(1)}$	V
Hypholoma fasciculare (Huds.: Fr.) P. Kumm. var. *subviride* (Berk. & M. A. Curtis) Krieglst.	S	4^{1-2b}			2^{1-2a}	2^{1-3}	1^{2a}	IV
Crucibulum laeve (Huds.) Kambly	S	3^{1-2b}	7^{1-2b}			2^{1-2a}	$1^{(1)}$	IV
Psilocybe cyanescens Wakef.	S	3^{1-2a}	1^{1}	1^{1}				III
+ *Stereum hirsutum* (Wild.: Fr.) Gray	S	3^{1-2a}	4^{1-2a}		2^{1-2a}	2^{1}	2^{1-2b}	V
Annulohypoxylon multiforme (Fries) Y. M. Ju. Rogers & Hsieh var. *multiforme*[2]	S	3^{1}	2^{1-2a}		1^{1}		1^{2a}	IV
+ *Trametes versicolor* (L.: Fr.) Pilát	S	2^{1-2b}	5^{1-2a}		2^{1}	3^{1-2a}	$1^{[1]}$	V
Hypholoma capnoides (Fr.: Fr.) Kumm.	S	2^{1-2a}	1^{1}		1^{1}	1^{1}		IV
+ *Daedaleopsis confragosa* (Bolt.: Fr.) J. Schröt.	S	1^{3}	2^{1-2a}	3^{1-2a}	4^{1-2a}	5^{1-2a}		V
Pholiota flammans (Batsch: Fr.) P. Kumm.	S	1^{1}			1^{2a}			II
+ *Pluteus cervinus* (Schaeff.) P. Kumm.	S	1^{1}				1^{1}	1^{1}	III
+ *Trametes hirsuta* (Wulf.: Fr.) Pilát	S	1^{1}				1^{1}	2^{1}	III
Ascocoryne sarcoides (Jacq.) J. W. Groves & D. E. Wilson	S	1^{1}					1^{1}	II
Xylaria filiformis (Albertini & Schweinitz) Fries	S	1^{1}					1^{1}	II
Hymenoscyphus serotinus (Pers.: Fr.) W. Phillips	S	1^{1}					1^{1}	II
* *Inonotus radiatus* (Sowerby: Fr.) P. Karst.	P/S	1^{1}	7^{1}		3^{1}			III
Mycena stipata Maas. G. & Schwöbel	S	1^{1}	2^{1-2a}		2^{1}			III
Tubercularia vulgaris Toode: Fr.	S		6^{1}					I
Diatrype disciformis (Hoffmann) Fries[2]	S		2^{1-3}					I
* *Tympanis alnea* (Pers.) Fr.	S		2^{1-2a}					I
Clibanites paradoxa P. Karst.[3]	S		1^{1}					I
Cylindrobasidium leave (Pers.: Fr.) Chamuris	S		1^{1}					I
Dacryomyces stillatus Nees: Fr.	S		1^{1}					I
Datronia mollis (Sommerf.: Fr.) Donk[1]	S		1^{1}					I
Pleurotus ostreatus (Jacq.: Fr.) P. Kummer	S		1^{1}					I
Pluteus leoninus (Schaeff.: Fr.) P. Kumm.	S		1^{1}					I
Radulomyces confluens (Fr.: Fr.) M. P. Christ.[1]	S		1^{1}					I
Skeletocutis nivea (Jungh.) Keller	S		1^{1}					I
Tremella foliacea Pers.	S		1^{1}					I
Xeromphalina campanella (Batsch: Fr.) Kühner & Maire	S		1^{2b}					I
* *Stereum subtomentosum* Pouzar	S		1^{2a}					I
Coprinellus disseminatus (Pers.: Fr.) J. E. Lange	S		5^{2a-3}				$1^{(1)}$	II
Phellinus igniarius (L.: Fr.) Quél.	S		3^{1}		1^{1}			II
Coprinellus micaceus (Bull.: Fr.) Vilgalys	S		2^{1-2a}	1^{2a}				II
Clavariadelphus fistulosus (Holmsk.: Fr.) Corner	S		2^{1}		2^{1-2a}			II
+ *Bjerkandera adusta* (Willd.: Fr.) P. Karst.	S		1^{2a}			1^{1}	$1^{[2a]}$	III
Lasiosphaeria ovina (Persoon) Cesati & De Notaris[2]	S		1^{2a}				1^{2b}	II
Scutellinia scutellata (L.) Lambotte	S		1^{1}	1^{1}				II
Pluteus nanus (Pers.: Fr.) P. Kumm.	S		1^{1}			1^{1}		II
Pholiota adiposa (Batsch: Fr.) P. Kumm.	S		1^{1}		1^{1}	1^{2a}		III

Table 2. *Continued.*

Taxon	Tg	1	2	3	4	5	6	C
Psathyrella pygmaea (Bull.: Fr.) Singer	S			1[1]				I
Tremiscus helvelloides (DC.: Fr.) Donk	S			1[1]				I
Heterobasidion annosum (Fr.) Bref.	P/S				1[2a]			I
Lycoperdon pyriforme Shaeff.: Pers.	S				1[2a]			I
Xylaria polymorpha (Persoon) Greville	S				1[2a]			I
Exidia plana (Wiggers) Donk	S				1[1]			I
Hyphodontia sambuci (Pers.: Fr.) J. Erikss.	S				1[1]			I
Pluteus podospileus Sacc. & Cub.	S				1[1]			I
+ *Armillaria ostoyae* (Romagn.) Herink	S					1[2b]		I
Diatrype bullata (Hofm.: Fr.) Tul.[3]	S					1[2a]		I
Mycena adscendens (Lasch) Maas Geest.	S					1[2a]		I
Pholiota lubrica (Pers.: Fr.) Singer	S					1[1]		I
Cosmospora sp.[4]	S						1[1]	I
Delicatula integrella (Pers.: Fr.) Pat.	S						1[1]	I
Mycena polygramma (Bull.: Fr.) Gray	S						1[1]	I
Peniophora cinerea (Pers.: Fr.) Cooke	S						1[1]	I
Skeletocutis amorpha (Fr.: Fr.) Kotl. & Pouzar	S						1[1]	I
ON MOSSES								
Rickenella fibula (Bull.: Fr.) Raithelh.	P		1[1]			1[1]		II
Rickenella swartzii (Fr.: Fr.) Kuyper	P		1[1]				1[1]	II
ON FUNGI								
Collybia tuberosa (Bull.: Fr.) P. Kumm.	S	2[1-2a]						I
Volvariella surrecta (Knapp) Singer	P			1[2a]				I
ON INSECTS								
Paecilomyces farinosus (Holm.: S. F. Gray) Brown & Smith	P	1[1]			1[1]	1[1]	2[1]	IV
Cordyceps bifusispora O. Eriksson	P					2[1]		I
Ophiocordyceps entomorrhiza (Dicks.) G. H. Sung	P					1[1]		I

[1] – det. Å. Strid, [2] – det. A. Chlebicki, [3] – det. A. Rossman, [4] – det. H. Komorowska, ( ) – Skawica-Żurkowo, [ ] – Zawoja-Pająki, * – characteristic species of Central European grey alder forests (Griesser 1992), ** – constant and characteristic species of Central European grey alder forests (Griesser 1992), + – constant species of Central European grey alder forests (Griesser 1992)

description of the recorded basidiocarps (POZM, Zaw. 258) is as follows: cap 0.4–1.3 cm, umbonate shallowly depressed, striate, grayish brown, hygrophanous; gills sinuate or subdecurrent, pinkish gray, margin reddish; stipe 2.3/0.3 cm, smooth, blackish brown with violet bluish shine in some specimens, central or excentric; smell ± farinaceous; spores elliptical, 5.7–7.6 × 3.8–4.7 µm, verrucose; pseudocystidia with red-brown pigment, 25–50 × 6.25–8.75 µm; caulocystidia shaped like pseudocystidia. Basidia 4-spored.

Rhodocybe ardosiaca was recorded in Białka (locality X) on moist ground among moss *Oxyrrhynchium hians* on 15 September 1994 and on 31 August 1995, and in Zawoja-Pająki (locality XI) on the ground on 6 September 1995 (*leg. A. Bujakiewicz*). It was newly described and illustrated by Horak and Griesser (1987) from montane *Alnus incana* forests in eastern Switzerland. According to them this species is associated with *Alnus incana* forests (Ludwig 2001). Some collections of *Rhodocybe ardosiaca* were also described and illustrated by Dämon (1993) from floodplain forest of *Salici-Populetum* type along the Saalach River near Salzburg. *Rhodocybe ardosiaca* was also recorded in xerothermophilic grass mats in the vicinity of

Fig. 2. *Echinoderma jacobi* (Vellinga & Knudsen) Gminder. Photo A. Bujakiewicz. Scale bar = 25 mm.

Kaiserstuhls (Germany) (Laber *et al.* 1995). This species is very rare both in Poland (D. Karasiński, pers. comm.) and in Europe (Ludwig 2001). *Rhodocybe ardosiaca* grows mostly in woods.

Interestingly, the group of basidiocarps growing on bare humose ground is nearly always represented by only a few genera of fungi, mostly *Lepiota* s.l. (*Cystolepiota*, *Echinoderma*, *Lepiota*, *Melanophyllum*), *Conocybe*, *Pholiotina*, *Entoloma*, and *Coprinopsis*. They occur repeatedly and rather constantly in various riverine forests, though infrequently and scattered.

Litter-dwelling fungi comprise 68 taxa (23%) occupying various kinds of debris of broadleaved and coniferous trees. The most abundant and constant are *Psathyrella candolleana*, *Mycena speirea* and *Marasmius vaillantii*. Equally abundant but less constant were *Mycena acicula*, *Coprinellus domesticus*, *Marasmius torquescens* and *Crepidotus luteolus*.

Characteristic is the mass occurrence of small whitish carpophores of *Typhula uncialis*, *Calyptella capula* and *Hemimycena pseudocrispula* on dead petioles and stems of *Petasites kablikianus* in almost all observation plots.

Worth noting is the occurrence of *Ramaria decurrens*. The recorded basidiocarps (POZM, Zaw. 311) were coral-like, smooth and elastic; branches cream yellow, 4–5 cm tall, 3–4 cm broad, not discoloring when bruised, stipe whitish cream ochre; whitish rhizomorphs, crystals star-shaped; taste and smell of flesh not evident; spores elliptical or drop-shaped, spiny, 5.0–7.6 × 2.8–3.8 µm; basidia with four sterigmata and basal clamp. *Ramaria decurrens* was recorded in Zawoja (locality VI and VII) among litter on 4 September 1995 and 22 August 1996 (*leg. A. Bujakiewicz*). This species is rarely recorded, and not only in Poland (D. Karasiński, pers. comm.), for example, it is rare in Germany (Gminder *et al.* 2000).

Lignicolous fungi form the most abundant group, with 103 species (35%). The dominant species are *Mycena haematopus*, *Annulohypoxylon multiforme* and *Inonotus radiatus* (Table 2).

The most interesting species is *Clibanites paradoxa*. Zawoja (ZC I) is the second locality of this species in the world. *Clibanites* is a unispecific genus originally described by Karsten as a discomycete. It is similar to *Nectriopsis* in

Fig. 3. *Entoloma pleopodium* (Bull.: Fr.) Noordel. Photo A. Bujakiewicz. Scale bar = 12 mm.

the *Bionectriaceae*. It differs from *Nectriopsis* in having relatively thick-walled ascomata loosely united in a common stroma and in its non-fungicolous habit. Previously it was known only from the type specimen collected in Runsala, Finland, on wood of *Quercus* 26 May 1861, P. Karsten (acc. to Rossman *et al.* 1999). It was recorded in Zawoja (locality VII) on decorticated twigs of a broad-leaved tree (*Acer* spp., *Alnus* sp.?) on 12 August 1993 (*leg. A. Bujakiewicz*, *det. A. Y. Rossman*).

Threatened species recorded are *Lentinellus flabelliformis* (E) and *Tremiscus helvelloides* (R). *Psilocybe cyanescens* and *Tympanis alnea* are rare. *Psilocybe cyanescens* is a widespread fungus growing late in the season on or among woody debris in forests as well as in ruderal places. It prefers cooler habitats (Ludwig 2001). *Tympanis alnea* is known in Poland mainly from historical data (Chmiel 2006). In present times it was noted in the Bieszczady Mts (Domański *et al.* 1970) and in Zawoja (Bujakiewicz 2004).

Among the macrofungi growing on other substrates, *Cordyceps bifusispora* grows on pupae of *Lepidoptera* (Bujakiewicz *et al.* 2005). It now has only a few records in Poland (Nita & Bujakiewicz 2007). *Volvariella surrecta*, a parasitic fungus on basidiocarps of *Clitocybe nebularis* (Fig. 5), has only a few records from Poland published (Celka 2000; Narkiewicz 2000; Bujakiewicz 2004; Kujawa & Gierczyk 2007).

There are far-reaching similarities and regularities in the occurrence of macrofungi in the *Alnetum incanae* association studied in Poland and in the grey alder forest *Calamagrostio-Alnetum incanae* association analyzed in the Rhine River valley in Switzerland (Griesser 1992). Table 2 presents the occurrence and relationship of characteristic and constant species of Central European alder forests considered by Greisser (1992) and also growing in the studied *Alnetum incanae* forests.

The percentages of trophic forms are as follows: saprotrophic fungi 85.1% (245 species), ectomycorrhizal 10.7% (31) and parasitic 4.5% (12). In terms of substrate, terricolous saprobic fungi (humicolous and litter fungi) comprise 50.8% (147 species), ectomycorrhizal 10.7% (31), lignicolous 35.6% (103) and others 2.7% (8). The occurrence of highly host-specific ectomycorrhizal symbionts is significant though scattered (e.g., *Cortinarius alnetorum*, *C. americanus*, *Lactarius lilacinus*). *Lactarius obscuratus*, *Inocybe calospora*, *Paxillus filamentosus*, *Russula alnetorum* and *Naucoria scolecina* are abundant.

The dominance of saprobic fungi (85.1%), both terricolous and lignicolous, is striking. Humicolous macrofungi growing on bare ground were noted in almost all studied localities. The most constant are *Cystolepiota seminuda*, *Pholiotina filaris*, *Entoloma dysthaloides*, *E. pleopodium* and *Echinoderma jacobi*.

The dominant genera of saprobic fungi are *Mycena* (17), *Conocybe* (10), *Entoloma* (10), *Lepiota* s.l. (10), *Coprinus* s.l. (8), *Psathyrella* (8), *Hymenoscyphus* (7), *Peziza* (6), *Clitocybe* (5) and *Pholiotina* (5). The dominant genera of ectomycorrhizal fungi are *Inocybe* (7), *Naucoria* (6), *Cortinarius* (4) and *Lactarius* (4).

Fructification generally was at low density and frequency. As many as 125 taxa (43.2%) were recorded once in one locality only, usually forming few carpophores. The clear dispersion of taxa and scattered occurrence of fruitbodies is the principal feature of the narrow forest belt of the riverside *Alnetum incanae* association. This feature is also characteristic of alluvial forests as such (Bujakiewicz 1989).

In the studied six localities, 164 species of exclusive fungal species (56%) were noted (Table 2). The most distinctive site, locality VI, yielded 59 exclusive species (42%). It is at the highest elevation, among beech forest with fir and spruce, and has greatest number of taxa encountered. In other places the number of exclusive species is as follows: VII – 34 (25.9%), VIII – 6 (14%), IX – 21 (22.8%), X – 26 (27.9%) and XI – 18 (27.7%).

Only some litter-dwelling species were more constant and occurring en masse (e.g., *Gymnopus confluens*, *Psathyrella candolleana*, *Marasmius rotula*, *Marasmiellus vaillantii*, and two species – *Calyptella capula* and *Typhula uncialis* – overgrowing decaying petioles of *Petasites kablikianus*).

As this study on mycobiota is a continuation of research on the *Caltho-Alnetum incanae* associa-

Fig. 4. *Limacella ochraceolutea* P. D. Orton. Photo A. Bujakiewicz. Scale bar = 25 mm.

tion (Bujakiewicz 2006), a number of similarities and differences between the two sets of observations should be pointed out. During 17 observations of 5 permanent plots of *Caltho-Alnetum* with a total area of 2000 m^2, 118 species of macrofungi were recorded. In contrast, the 6 observation plots of *Alnetum incanae* with a total area of 2200 m^2 yielded 288 species of macrofungi during 45 observations. The two sets have 75 species in common, which form 62% of the species in *Caltho-Alnetum* and 25% of them in *Alnetum incanae*. Exclusive species have a 74% share in *Alnetum incanae* and only a 37% share in *Caltho-Alnetum*.

In the boggy *Caltho-Alnetum* association there were much fewer ectomycorrhizal fungi, more taxa connected with *Fagus sylvatica*, and more montane species. On mineral gravely soil of the *Alnetum incanae* association a great diversity of species and even the mass occurrence of some ectomycorrhizal fungi were observed (e.g., *Lactarius obscuratus*, *Naucoria escharioides*, *Paxillus filamentosus*). Locality VI was distinguished by the mass occurrence of *Lactarius lilacinus* and *Russula alnetorum*. Other places were distinguished by the presence of various *Inocybe* species. The great mycodiversity of *Alnetum incanae* is underscored by the records of humicolous saprobic fungi growing on bare soil (e.g., *Lepiota* spp., *Cystolepiota* spp., *Conocybe* spp., *Echinoderma jacobi*, and *Limacella* spp). In the foothills, *Alnetum incanae* is also enriched by nitrophilous species such as *Coprinellus* spp., *Cyathus striatus*, *Crucibulum laeve*, *Calvatia excipuliformis* and various *Psathyrella* species.

The most striking group of macrofungi common to both discussed types of grey alder forest is formed by those growing on decaying petioles and stems of *Petasites kablikianus*, mostly *Calyptella capula*, *Typhula uncialis* and *Hemimycena pseudocrispula*.

The riverside *Alnetum incanae* association is a shelter for various rare and threatened macrofungi. Many species were recorded in several localities, including *Echinoderma jacobi* (E), *Rhodocybe nitellina* (E), *Lentinellus flabelliformis* (E), *Inocybe calospora* (V), *Russula alnetorum* (V), *Crepidotus luteolus* (V), *Limacella glioderma* (V) and *Psathyrella noli-tangere* (V). Others occur sparsely, such as *Agrocybe firma* (E), *Mycena pterigena* (V), *Antrodia heteromorpha* (R), *Lactarius lilacinus* (R), *Melanophyllum haematospermum* (R), *Phaeomarasmius erinaceus* (R) and *Tremiscus*

Fig. 5. *Volvariella surrecta* (Knapp) Singer. Photo A. Bujakiewicz. Scale bar = 10 mm.

helvelloides (R) (Wojewoda & Ławrynowicz 2006). Many species should be listed as threatened fungi, above all such rare taxa as *Cordyceps bifusispora* (E), *Limacella ochraceolutea* (E) and *Volvariella surrecta* (E).

Alder forests are very rich in macrofungi but are rarely incorporated into more comprehensive mycocoenological research in a given area. In spite of the great mycodiversity found, it should be stressed that the present research has not been performed long enough or frequently enough to ascertain the full qualitative range of macrofungi that may occur there. Work on the vernal and late autumnal aspects of mycobiota not taken into account during this study will no doubt provide records of more and various fungi.

AKNOWLEDGEMENTS. I am grateful to my friends and colleagues for determining some collections: Dr. Amy Y. Rossman (Beltsville, MD, U.S.A.), Dr. Åke Strid (Stockholm), Prof. Andrzej Chlebicki (Kraków) and Dr. Halina Komorowska (Kraków). Special thanks to Prof. Andrzej Brzeg (Poznań) for making the phytosociological relevés, Dorota Obiegała for technical preparation of the manuscript, and the anonymous reviewers for helpful comments and suggestions. In 1992–1994 the study was funded in part by the Polish State Committee for Scientific Research (KBN).

REFERENCES

BORATYŃSKI A. 1980. Systematics and geographic distribution of alders. In: S. BIAŁOBOK (ed.), *Olsze, Alnus Mill.*, pp. 35–71. Państwowe Wydawnictwo Naukowe, Warszawa – Poznań (in Polish with English summary).

BREITENBACH J. & KRÄNZLIN F. 2000. Fungi of Switzerland. **5**(3). Edition Mykologia, Lucerne.

BRUNNER I. & HORAK E. 1990. Mycoecological analysis of *Alnus*-associated macrofungi in the region of the Swiss National Park as recorded by J. Favre (1960). *Mycologia Helvetica* **4**: 111–139.

BUJAKIEWICZ A. 1989. Macrofungi in the alder and alluvial forests in various parts of Europe and North America. *Opera Botanica* **100**: 29–41.

BUJAKIEWICZ A. 1993. General remarks on macrofungi occurring in boreal and temperate grey alder forests. *Blyttia* **3–4**: 99–110.

BUJAKIEWICZ A. 2004. Macrofungi of the Babiogórski National Park. In: B. W. WOŁOSZYN, A. JAWORSKI & J. SZWAGRZYK (eds), *The nature of the Babiogórski National Park. Monograph*, pp. 215–257. Komitet Ochrony Przyrody PAN, Babiogórski Park Narodowy, Kraków (in Polish with English summary).

BUJAKIEWICZ A. 2006. Macrofungi in the *Caltho-Alnetum* association on the northern slopes of the Babia Góra massif (West Carpathians). *Polish Bot. Stud.* **22**: 81–93.

BUJAKIEWICZ A. 2010. On some agarics occurring in carr forests. *Acta Mycol.* **45**(1): 73–89.

BUJAKIEWICZ A., NITA J. & BAŁAZY S. 2005. First localities in Poland of the recently described fungus – *Cordyceps bifusispora*. *Acta Mycol.* **40**(2): 251–258.

CELKA D. 2000. *Volvariella surrecta* – a new species in the mycoflora of Poland. *Acta Mycol.* **35**(2): 153–156.

CHMIEL M. A. 2006. Checklist of Polish larger Ascomycetes. Szafer Institute of Botany, Polish Academy of Sciences. Kraków.

DÄMON W. 1993. Bemerkenswerte Pilzfunde aus einem Silberweidenauenwald an der Saalach (bei Salzburg). *Östereichische Zeitschrift für Pilzkunde* **2**: 19–32.

DOMAŃSKI S., LISIEWSKA M., MAJEWSKI T., SKIRGIEŁŁO A., TRUSZKOWSKA W. & WOJEWODA W. 1970. Mycoflora of West Bieszczady. IV. (Zatwarnica 1965). *Acta Mycol.* **6**(1): 129–179 (in Polish with English summary).

EINHELLINGER A. 1973. Die Pilze der Pflanzengesellschaften des Auwaldgebiets der Isar zwischen München und Grüneck. *Ber. Bayer. Bot. Ges.* **44**: 5–100.

GMINDER A., KRIEGLSTEINER G. J. & WINTERHOFF W. 2000. Die Grosspilze Baden-Württembergs. **2**. Verlag Eugen Ulmer, Stuttgart.

GRIESSER B. 1992. Mykosoziologie der Grauerlen – und Sand-dorn-Auen (*Alnetum incanae*, *Hippophaëtum*) am Hinterrhein (Domelschag, Graubünden, Schweiz). *Veröff. Geobot. Inst. ETH Stiftung Rübel Zürich* **109**: 1–235.

HORAK E. 1985. Die Pilzflora (Makromyceten) und ihre Ökologie in fünf Pflanzengesellschaften der montan-subalpinen Stufe des Unterengadins (Schweiz). *Ergebn. Wiss. Untersuch. Schweiz. Nationalparkes* **12**: 337–476.

HORAK E. & GRIESSER B. 1987. Über zwei neue Arten von *Psathyrella* und *Rhodocybe* aus Grauerlen-Wäldern Granbündens (Schweiz). *Beiträge zur Kenntnis der Pilze Mitteleuropas Arbeitsgemeinschaft Mykologie Östwürttemburg* **3**: 265–274.

KNUDSEN H. & VESTERHOLT J. 2008. Funga Nordica. Agaricoid, Boletoid and Cyphelloid genera. Nordsvamp, Copenhagen.

KREISEL H. 1987. Pilzflora der Deutschen Demokratishen Republik. Basidiomycetes. G. Fisher Verlag, Jena.

KUJAWA A. & GIERCZYK B. 2007. Register of protected and endangered fungi species. Part II. A list of species recorded in 2006 year. *Przegląd Przyrodniczy* **18**(3–4): 3–70.

LABER D., BAIRENTHER S., BUND E., HILL H. P., SCHRIMPL L. & STAHL U. 1995. Pilze auf Trockenrasen des Keiser stuhls. Ein Exkursionsbericht (Teil II). *Südwestdeutsche Pilzrundschau* **31**(1): 3–10.

ŁAWRYNOWICZ M., BUJAKIEWICZ A. & MUŁENKO W. 2004. Mococoenological studies in Poland 1952–2002. *Monogr. Bot*. **93**: 1–102.

LUDWIG E. 2001. Pilzkompendium 1. IHW-Verlag, Eching.

MIREK Z., PIĘKOŚ-MIRKOWA H., ZAJĄC A. & ZAJĄC M. 2002. Flowering plants and pteridophytes of Poland a checklist. W. Szafer Institute of Botany, Polish Academy of Sciences. Kraków.

MOSER M. 1949. Untersuchungen über den Einfluss von Waldbranden auf die Pilzvegetation. I. *Sydowia* **3**: 336–383.

NARKIEWICZ C. 2000. Der Parasitische Scheidling *Volvariella surrecta* in Westlichen Sudetengebirge. *Przyroda Sudetów Zachodnich* **3**: 73–76 (in Polish with German summary).

NITA J. & BUJAKIEWICZ A. 2007. Riparian and alder forests – schelters for rare and threatened macrofungi. In: D. ANDERWALD (ed.), *Habitats and indicative species in the forests. Part. 2. Proceedings of the Center for Nature and Forestry Education, Rogów* **9**(2/3): 519–529 (in Polish).

ROSSMAN A. Y., SAMUELS G. J., ROGERSON C. T. & LOWEN R. 1999. Genera of Bionectriaceae, Hypocreaceae and Nectriaceae (Hypocreales, Ascomycetes). *Stud. Mycol.* **42**: 1–248.

STANGL J. 1989. Die Gattung *Inocybe* in Bayern. *Hoppea* **46**: 1–409.

TRAPPE J. M. 1962. Fungus associates of ectotrophic mycorrhizae. *Bot. Rev*. **28**: 538–606.

WOJEWODA W. 2003. Checklist of Polish larger Basidiomycetes. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

WOJEWODA W. & ŁAWRYNOWICZ M. 2006. Red list of the macrofungi in Poland. In: Z. MIREK, K. ZARZYCKI, W. WOJEWODA & Z. SZELĄG (eds), *Red list of plants and fungi in Poland*, pp. 53–70. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

WOJTERSKI T. 1980. Alder forests. In: S. BIAŁOBOK (ed.), *Olsze, Alnus Mill.*, pp. 259–279. Państwowe Wydawnictwo Naukowe, Warszawa – Poznań (in Polish with English summary).

ZARZYCKI K. 1956. Die Bewachsungsstadien der Flussaluvionen der Skawica und Skawa in den Westbeskiden. *Fragm. Florist. Geobot.* **2**(1): 111–142 (in Polish with German summary).

Received 15 July 2011