

## Preliminary studies of fungi in the Biebrza National Park (NE Poland). I. Micromycetes

MAŁGORZATA RUSZKIEWICZ-MICHALSKA<sup>1</sup>, CEZARY TKACZUK<sup>2</sup>, MARIA DYNOWSKA<sup>3</sup>,  
EWA SUCHARZEWSKA<sup>3</sup>, JAROSŁAW SZKODZIK<sup>4</sup> and MARTA WRZOSEK<sup>5</sup>

<sup>1</sup>Department of Mycology, Faculty of Biology and Environmental Protection  
University of Łódź, Banacha 12/16, PL-90-237 Łódź, mrusz@biol.uni.lodz.pl

<sup>2</sup>Department of Plant Protection, Siedlce University of Natural Sciences and Humanities  
Prusa 14, PL- 08-110 Siedlce, tkaczuk@uph.edu.pl

<sup>3</sup>Department of Mycology, Warmia and Mazury University in Olsztyn  
Oczapowskiego 1A, PL-10-957 Olsztyn, dynow@uwm.edu.pl, ewko@uwm.edu.pl

<sup>4</sup>Nature & Ecology of Łódź Macroregion Website, Ekolodzkie.pl, jaroslaw.szkozik@ekolodzkie.pl

<sup>5</sup>Department of Plants Systematics and Geography, University of Warsaw  
Al. Ujazdowskie 4, PL-00-478 Warszawa, mwrzosek@biol.uw.edu.pl

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This paper presents the results of the first short-term inventory of fungi species occurring in the Biebrza National Park, one of the biggest and best preserved protected areas of Poland. The paper is focused on a survey of microfungi. Fungi were collected in early autumn 2012, within the framework of a scientific project by the Polish Mycological Society. The results are published in two parts containing micro- and macromycetes, respectively. An annotated list of 188 identified taxa covers true fungi including 33 zygomycetes, 130 ascomycetes (including anamorphs) and 22 basidiomycetes, as well as two chromistan and one protozoan fungal analogues. The identified fungi taxa, inhabiting diverse ecological niches, represent a wide range of trophic groups including biotrophic and necrotrophic parasites of plants, pathogens of arthropods, fungicolous fungi and saprotrophs isolated from soil and organic matter. From 188 annotated taxa, 89% (167 species) have not been recorded in the Biebrza National Park until now and four species are newly reported for Poland (*Alternaria nobilis*, *Clonostachys solani*, *Mariannaea elegans*, *Metasphaeria cumana*). Data on the species richness and taxonomic diversity of the identified fungi are briefly commented in terms of micromycetes role in managing nature conservation.

**Key words:** all-species inventory, micromycetes, plant parasites, arthropod pathogens, soil fungi, fungal ecology, protected area

## INTRODUCTION

A comprehensive knowledge of the organisms inhabiting national parks provides a basis for developing and improving species protection rules and range. For many hemerophobic species, national parks are a kind of lair where populations of rare species can survive and thrive and spread to adjacent areas. In general, reconnoitring of the biota of organisms occurring in a particular area is classically the first, necessary step in planning and processing their protection. This concerns fungi in particular as they are symbionts (mutualists and antagonists) and decomposers that crucially influence ecosystem functioning. Fungi, often neglected in the past, are currently more often considered in conservation plans (Dahlberg et al. 2011), however, it is still necessary to understand and enlighten the role of micromycetes in nature conservation strategies (e.g., Denchev 2005; Ingram 2002). As many micromycetes are parasites and pathogens, they are usually considered as unworthy of protection and are very rarely included in the red lists (e.g., Helfer 1993; Denchev 2005; Minter 2007, 2011).

The Biebrza National Park (BbNP) is relatively young (established in 1993) and is the largest (59.223ha, with a 66.824ha buffer zone) national park in Poland. The park was brought to life to conserve the entire river valley, from its sources to the mouth, making it unique within Europe (Dyrcz, Werpachowski 2005). The natural longitudinal and transversal zonation of habitats and corresponding plant communities of the river valley, as well as a large complex of fens are preserved in an almost unchanged state. Peatlands are predominant among the habitats of the Biebrza valley, occupying approximately 82.000ha, of which two thirds are within the area of the national park. Forest communities (mainly alder and birch swamp forests) occupy only *ca* 26% of the BbNP area. To the total habitat and plant diversity of the BbNP greatly contribute diverse mineral 'islands' (called *grądzik* or *grąd*). They are characterized by high heterogeneity of habitats and related plant communities (aquatic, semi-aquatic, rushes, thickets, forests, grasslands and anthropogenic ones) (Werpachowski 2005). Although these 'islands' constitute only 1% of the total area of the Biebrza Valley, they host about 80% of its total flora (appraised on 1015 plant species).

The only group of fungi studied in relative depth in the area of the BbNP are soil mitosporic zygomycetes and ascomycetes (Tyszkiewicz 2004a, b, 2012). However, works by Tyszkiewicz (l.c.) present the variability of the fungi in peat profiles, rather than their diversity in different plant communities. Particular attention has been paid to soil- and litter-inhabiting micromycetes (mainly zygomycetes and amorphous fungi) from Biele Suchowolskie fen after a severe, long-lasting fire which happened in 2002 (Wilk 2009; Boulahdjel 2010; Budziszewska et al. 2010). In the survey by Budziszewska et al. (2010), 41 zygomycetous species of soil fungi are listed from the area of the Biebrza Valley. The authors compared burnt and unburnt areas in terms of fungal richness and diversity. No inventory research on other groups of non-lichenized fungi has been conducted in the BbNP while the lichens have been surveyed by Kolanko (2005, incl. literature cited therein).

Creating an inventory of fungi and slime mould biodiversity in the vast and diverse area of the BbNP is the first scientific project of the Polish Mycological Society,

officially created at the end of 2011. The results of the short-term studies on fungi are presented in two consecutive papers. This one deals with species classified as micromycetes, while the second part (Kujawa et al. 2012, this issue) covers macromycetes. A few other micromycetes new to Poland will be the subject of forthcoming papers.

## MATERIALS AND METHODS

The study was carried out on 28.08.–01.09.2012 in the central area of the BbNP and in particular in three protective units (Grzędy, Kapice and Werykle). Some observations were also conducted at the area of the Osowiec Fortress, located close to the park border. A map of the surveyed localities is included in the paper by Kujawa et al. (2012). Materials consisted of the fungi of different taxonomic and trophic groups, inhabiting diverse substrates and ecological niches, arbitrarily treated in the paper as micromycetes (in the way adopted in Polish checklists, cf. Mułenko et al. 2008, Wojewoda 2003 and Chmiel 2006).

Fungi were collected according to group-specific methods (cf. Mułenko 2008; Tkaczuk et al. 2011b) in a range of habitats, mainly in phytocoenoses of lime-oak-hornbeam forest (*Tilio cordatae-Carpinetum betuli*), continental swamp/bog pine forest (*Vaccinio uliginosi-Pinetum*), as well as in patches of sand grasslands (*Koelerio glaucae-Corynepheretea* class) covering inland dunes. Fungi were also gathered from coniferous, deciduous and mixed forests (without determination of their syntaxonomic affinity) and from other habitats, including forest edges, roadsides, pathways, meadows, etc. The substrate of every species was determined and listed together with locality, date of collection and collector/identifier name(s).

Standard methods for studying each taxonomic group were used in the species identification (cf. Dynowska, Ejdyś 2011; Keller 1987; Bałazy 1993; Goettel, Inglis, 1997; Budziszewska et al. 2010). Identification was based on microscopic analyses using light microscope with 'phase contrast' and magnification 100-1000x and hand-made sections or squash preparations mounted in water, lactophenol blue, lactophenol picric acid solution or aceto-orcein. The soil fungi were isolated by the soil dilution plate method on potato dextrose agar, the bait method, using dry shrimps and gammarids as baits, to obtain species belonging to Kickxellales (Bills et al. 2004; Kurihara et al. 2008) and Warcup soil plate technique (Warcup 1950). Some saprobic species were obtained directly from organic material stored in moist chambers (Kurihara, Degawa 2006).

The following monographs and keys were used: Braun (1995a, b, 1998), Domsch et al. (1993), Ellis, Ellis (1997), Gams (1977), Hoffmann et al. (2007), Ignatavičiūtė, Treigienė (1998), Kochman, Majewski (1970, 1973), Majewski (1977, 1979), Nannfeldt (1981), Sałata (1985), Skirgieĭlo, Zadara (1979), Vanev et al. (1997), Watanabe (2002), Wołczańska (2005), Zheng, Chen (2001) and Zycha et al. (1969). Host plant species were determined using the key by Rutkowski (2004). Taxonomic system of fungi and fungus-like organisms of Kirk et al. (2008) is adopted while nomenclature follows Keller (2007), Mułenko et al. (2008), and *Index Fungorum*. Names of plants

and arthropods are given after Mirek et al. (2002) and Schaefer (2010), respectively, while syntaxonomic nomenclature follows Matuszkiewicz (2006).

The specimens documenting research are deposited in the Fungal Collection of the Herbarium Universitatis Lodzianis (LOD), in the Herbarium of the Faculty of Biology, University of Warsaw (WA) as well as in Fungal Collection of Department of Plant Protection of Siedlce University of Natural Sciences and Humanities, and in the Department of Mycology of the Warmia and Mazury University in Olsztyn.

## RESULTS

In total, 188 fungal taxa were identified as the result of four days of field surveying. A number of interesting specimens still await determination. The recorded species belong to true fungi: 33 zygomycetes (Entomophthorales, Kickxellales, Mortierellales, Mucorales, Zoopagales), 130 ascomycetes (Capnodiales, Dothideales, Erysiphales, Hypocreales, Phyllachorales, Pleosporales, Xylariales, anamorphs) and 22 basidiomycetes (Exobasidiales, Pucciniales, Urocystales), as well as to chromistan (Peronosporales) and protozoan (Dictyostelida) fungal analogues (Tab. 1). The predominant group (135 species) comprises micromycetes associated with aboveground plant organs and other fungi. Fungi isolated from the soil (36 species) are the next numerous group and arthropod pathogens (17) are less numerous.

The following abbreviations and symbols are used in the lists of species: KPU – Kaplice protective unit; GPU – Grzędy protective unit; WPU – Werykle protective unit; *T-C* – *Tilio cordatae-Carpinetum betuli*; *V-P* – *Vaccinio uliginosi-Pinetum*; (a) – anamorphic stage; (t) – teleomorphic stage; (0, I, II, III) – successive stages of rust fungi; \* – species new to Poland. Initials of the names are given to denote collecting and/or identifying person (e.g., JS – Jarosław Szkodzik).

Table 1  
Numbers of species of fungi and fungus-like organisms collected at the study area

Group of fungi s.l.	No.
anamorphic fungi <sup>1</sup>	79
Capnodiales	4
Dictyostelida	1
Dothideales	1
Entomophthorales	6
Erysiphales	22
Exobasidiales	1
Hypocreales (incl. anamorphs)	13
Kickxellales	2
Mortierellales	6
Mucorales	14
Peronosporales	2
Phyllachorales	1
Pleosporales	2
Pucciniales	20
Urocystales	1
Xylariales	8
Zoopagales	5
<b>In total</b>	<b>188</b>

<sup>1</sup> - species with uncertain or unknown anamorph-teleomorph connection, presumably ascomycetes

**Micromycetes associated with plants.** Among 135 taxa identified, the most numerous were anamorphs of ascomycetes (71 species), while Pucciniales (20) and Erysiphales (22) are represented by a lower number of species. Other taxa (Capnodiales, Dothideales, Exobasidiales, Hypocreales, Peronosporales, Phyllachorales, Pleosporales, Urocystales, Xylariales) contribute to a lesser extent to the list. Two species are new in Polish mycobiota: *Alternaria nobilis* and *Metasphaeria cumana*. The majority of taxa enumerated below are common in Poland (cf. Mułenko et al. 2008), with the exception of *Asteromella eupatoriicola*, *Cercospora berteroeae*, *Ectostroma iridis*, *Fusicladium scribnerianum*, *Exobasidium rostrupii*, *Mycosphaerella iridis*, *Paraconiothyrium tiliae* and *Septogloeum carthusianum*, each known from a single locality. The other six species are rarely recorded in Poland.

The highest species richness of micromycetes associated with plants was observed in patches of *Tilio-Carpinetum* (65 species), while sand grassland (*Koelerio glaucae-Corynepherea* class) and *Vaccinio uliginosi-Pinetum* hosted lower number of taxa (24 and 9 species, respectively). Recorded fungi species predominantly occupied leaves and only a small number occurred on stems, flowers and fruits. Logs, stumps and fallen branches of deciduous trees were colonized by Xylariales and Hypocreales members. Among them the fungi of an early stage of wood decomposition (e.g., *Diatrypella favacea*, *D. quercina*, *Hypoxylon fuscum*, *Nectria cinnabarina*), as well as the saprotrophs of the later stages (*Annulohypoxylon multifforme*, *Nemania serpens*, *Xylaria longipes*), were distinguished.

In addition, 7 taxa of fungicolous fungi were found: *Dialonectria episphaeria* on old stromata of *Diatrypella favacea* and *Alternaria* sp. on the mycelium of an unidentified powdery mildew, as well as hyperparasites of Erysiphales (*Ampelomyces quisqualis*, *Phoma glomerata*) and Pucciniales (*Ramularia coleosporii*, *R. uredinearum*, *Sphaerellopsis filum*).

*Acronium* sp. s.l. on *Equisetum pratense* Ehrh., KPU, T-C, 28 Aug., leg. & det. MRM.

\**Alternaria nobilis* (Vize) Simmons [= *A. dianthi* Stevens & Hall] on *Dianthus carthusianorum* L., GPU, dune, sand grassland, 30 Aug., leg. MRM, det. MRM & ES.

*Alternaria* sp. on mycelium of an unidentified, sterile powdery mildew (on *Quercus petraea* (Matt.) Liebl. x *Q. robur* L.), KPU, T-C, glade, 28 Aug., leg. & det. MRM.

*Ampelomyces quisqualis* Ces. s.l. on *Microsphaera divaricata* (on *Frangula alnus*), GPU, V-P, 29 Aug., leg. & det. MRM; on *Golovinomyces sordidus* (on *Plantago intermedia*), KPU, T-C, edge of forest, 28 Aug., leg. & det. MRM; on *Neoerysiphe galeopsidis* (on *Galeobdolon luteum*), KPU, T-C, 28 Aug., leg. & det. MRM.

*Annulohypoxylon multifforme* (Fr.) Y.M. Ju, J.D. Rogers & H.M. Hsieh on log of deciduous tree, GPU, mixed forest, 29 Aug., leg. & det. JS.

*Ascochyta stellariae* Fautrey on *Stellaria holostea* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM.

*Ascochyta tenerima* Sacc. & Roum. on *Viburnum opulus* L., GPU, mixed forest, 29 Aug., leg. MRM, det. ES & MRM.

*Asteroma padi* DC. on *Padus avium* Mill., KPU, T-C, 28 Aug., leg. & det. MRM.

NOTE. Rare species, known from two records from southern and western part of Poland (Mułenko et al. 2008).

*Asteromella corcontica* (Kabát & Bubák) Moesz ex Bat. & Peres on *Hieracium* sp. sect. *Eu-Hieracium*, GPU, dune, sand grassland, 30 Aug., leg. MD, det. MRM & ES.

*Asteromella eupatoriicola* (Kabát & Bubák) Ruppr. on *Eupatorium cannabinum* L., GPU, V-P, roadside, 29 Aug., leg. & det. MRM.

NOTE. Species known from a single locality in central Poland (Ruskiewicz-Michalska 2006; Mułenko et al. 2008).

*Asteromella quercifolia* C. Massal. on *Quercus robur* L., GPU, deciduous forest, 29 Aug., leg. & det. ES.

*Asteromella tiliicola* (Oudem.) Arx on *Tilia cordata* Mill., KPU, T-C, 28 Aug., leg. & det. MRM.

*Asteromella trautmanniana* (Moesz) Moesz on *Sorbus aucuparia* L. emend. Hedl., GPU, mixed forest, 29 Aug., leg. & det. MRM; deciduous forest, 30 Aug., leg. & det. MRM.

*Cercospora berteroa* Hollós on *Berteroa incana* (L.) DC., GPU, dune, sand grassland, 30 Aug., leg. & det. MD & ES; same host, locality and date, leg. & det. MRM.

NOTES. Species only recently reported as new to Polish biota (Poteć, Ruskiewicz-Michalska 2012), collected primarily on the same host in the Łódź city in 2006. According to the newest molecular studies (Groenewald et al. 2012), *C. berteroa* is a synonym of *Cercospora amoraciae* Sacc., a species common in Poland (Mułenko et al. 2008).

*Cercospora mercurialis* Pass. on *Mercurialis perennis* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Cladosporium* sp. s.l. on *Acinos arvensis* (Lam.) Dandy, KPU, glade with tall herbs, 28 Aug., leg. & det. MRM; on *Anthoxanthum odoratum* L., KPU, T-C, 28 Aug., leg. & det. MD; on *Equisetum pratense* Ehrh., KPU, T-C, 28 Aug., leg. & det. MRM; on *Fragaria vesca* L., KPU, glade with tall herbs, 28 Aug., leg. & det. MRM; on *Quercus robur* L., GPU, deciduous forest, 29 Aug., leg. & det. ES.

*Coleosporium tussilaginis* (Pers.) Lév. (I<sup>II</sup>, III) on *Campanula* sp., GPU, mixed forest, 29 Aug., leg. & det. MRM; on *Melampyrum nemorosum* L., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, deciduous forest, glade, 29 Aug., leg. & det. MRM; GPU, dune, edge of sand grassland, 30 Aug., leg. ES, det. MD & ES.

*Colletotrichum dematium* (Pers.) Grove on *Asarum europaeum* L., KPU, T-C, 28 Aug., leg. MD, det. MD & ES; on *Maianthemum bifolium* (L.) F.W. Schmidt, KPU, T-C, 28 Aug., leg. & det. MRM; on *Polygonatum odoratum* (Mill.) Druce, GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. on *Anthoxanthum odoratum* L., KPU, T-C, 28 Aug., leg. MD, det. MD & ES.

NOTE. *A. odoratum* is a new host for the fungus in Poland.

*Coniothyrium olivaceum* Bonord. [= *Microsphaeropsis olivacea* (Bonord.) Höhn.] on *Sorbus aucuparia* L. emend. Hedl., GPU, deciduous forest, 30 Aug., leg. & det. MRM.

*Cronartium flaccidum* (Alb. & Schwein.) Winter (III) on *Vincetoxicum hirundinaria* Medik., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Dialonectria episphaeria* (Tode) Cooke on old stromata of *Diatrypella favacea*, KPU, T-C, 28 Aug., leg. & det. JS.

*Diatrype stigma* (Hoffm.) Fr. on fallen twigs of *Corylus avellana* L., KPU, T-C, 28 Aug., leg. & det. JS.

*Diatrypella favacea* (Fr.) Ces. & De Not. on fallen twigs of *Corylus avellana* L., KPU, T-C, 28 Aug., leg. & det. JS; on fallen twigs of deciduous tree, GPU, 29 Aug., leg. & det. JS.

*Diatrypella quercina* (Pers.) Cooke on fallen branches of *Quercus robur* L., KPU, T-C, 28 Aug., leg. & det. JS.

*Discosia artocreas* (Tode) Fr. on *Betula pubescens* Ehrh., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Discosia minuta* Ces. on *Polygonum mite* Schrank, KPU, T-C, 28 Aug., leg. & det. MRM; on *Vaccinium myrtillus* L., GPU, V-P, 29 Aug., leg. & det. MRM.

NOTE. Species rare in Poland (Wołczańska et al. 2004).

*Discosia* sp. on *Fallopia convolvulus* (L.) A. Löve, KPU, T-C, 28 Aug., leg. MD, det. MD & ES.

*Discula betulina* (Westend.) Arx on *Betula pendula* Roth, KPU, T-C, 28 Aug., leg. & det. MRM.

*Discula umbrinella* (Berk. & Broome) Morelet on *Quercus petraea* (Matt.) Liebl. x *Q. robur* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM.

*Ectostroma iridis* (Ehrenb.) Fr. on *Iris pseudoacorus* L., KPU, T-C, 28 Aug., leg. & det. MRM.

NOTE. Species know from a single locality in north eastern Poland (Durska 1974; Muleńko et al. 2008).

*Epicoccum nigrum* Link on *Stellaria holostea* L., KPU, T-C, 28 Aug., leg. & det. MD; on *Quercus robur* L., GPU, deciduous forest, 29 Aug., leg & det. ES.

*Erysiphe adunca* (Wallr.) Fr. [= *Uncinula adunca* (Wallr.) Lév.], (t), on *Salix caprea* L., GPU, mixed forest, 29 Aug., leg. ES, det. MD & ES; on *Salix* sp., GPU, edge of reeds' patch, near catwalk, 29 Aug., leg. & det. MRM; path near dune, 30 Aug., leg. MRM, det. ES; deciduous forest, 30 Aug., leg. & det. MRM.

*Erysiphe alphitoides* (Griffon & Maubl.) U. Braun & S. Takam. [= *Microsphaera alphitoides* Griffon & Maubl.], (t), on *Quercus robur* L., GPU, V-P, near catwalk, 29 Aug., leg. & det. MRM.

*Erysiphe aquilegiae* DC. var. *ranunculi* (Grev.) Zheng & Chen, (t), on *Ranunculus acris* L., GPU, mixed forest, pathway, 29 Aug., leg. & det. MRM.

*Erysiphe convolvuli* DC., (t), on *Convolvulus arvensis* L., GPU, dune, sand grassland, 30 Aug., leg. & det. MD.

*Erysiphe euonymi* DC. [= *Microsphaera euonymi* (DC.) Sacc.], (t), on *Euonymus europaea* L., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Erysiphe heraclei* DC., (a), on *Peucedanum oreoselinum* (L.) Moench., GPU, dune, sand grassland, 30 Aug., leg. & det. ES; on *Pimpinella major* (L.) Huds. (?), GPU, deciduous forest, 30 Aug., leg. MRM, det. ES.

*Erysiphe howeana* U. Braun, (a), on *Oenothera biennis* L. s.l., GPU, dune, sand grassland, 30 Aug., leg. & det. MRM.

*Erysiphe hypophylla* (Nevod.) U. Braun & Cunningt. [= *Microsphaera hypophylla* Nevod.], (t), on *Quercus robur* L., GPU, deciduous forest, 29 Aug., leg. & det. ES.

*Erysiphe ornata* var. *europaea* (U. Braun) U. Braun & S. Takam. [= *Microsphaera ornata* var. *europaea* U. Braun], (t), on *Betula pendula* Roth, KPU, T-C, 28 Aug., leg. & det. MRM; on *Betula pubescens* Ehrh., GPU, V-P, near catwalk, 29 Aug., leg. & det. MRM; same locality, mixed forest, 29 Aug., leg. & det. MRM.

*Erysiphe tortilis* (Wallr.) Link [= *Microsphaera tortilis* (Wallr.) Speer], (a), on *Cornus sanguinea* L., GPU, mixed forest, roadside, 29 Aug., leg. & det. MD.

*Erysiphe ulmariae* Pers. ex Desm., (t), on *Filipendula ulmaria* (L.) Maxim., GPU, willow thickets, near catwalk, 29 Aug., leg. & det. MRM.

*Exobasidium rostrupii* Nannf. on *Oxycoccus palustris* Pers., GPU, V-P, near catwalk, 29 Aug., leg. & det. MRM; same locality and date, leg. Grażyna Domian, det. MRM.

NOTE. Species known in Poland from a single locality in Poleski National Park (Mułenko 1988; Mułenko et al. 2008).

*Fusarium* sp. on *Daphne mezereum* L., GPU, mixed forest, 29 Aug., leg & det. MRM; on *Knautia arvensis* (L.) Coult, KPU, T-C, 28 Aug., leg. & det. MD; on *Stellaria holostea* L., KPU, T-C, 28 Aug., leg. & det. MD.

*Fusicladium scribnerianum* (Briosi & Cavara) M.B. Ellis on *Betula pendula* Roth, KPU, T-C, 28 Aug., leg. & det. MRM.

NOTE. Species known only on *Betula pendula* Roth in a single locality in central Poland (Ruskiewicz-Michalska, Połec 2006; Mułenko et al. 2008).

*Golovinomyces sordidus* (Junell) Heluta [= *Erysiphe sordida* Junell], (a), on *Plantago intermedia* Gillib., KPU, T-C, edge of forest, 28 Aug., leg. & det. MRM.

*Gymnosporangium cornutum* Arth. ex Kern (0, I) on *Sorbus aucuparia* L. emend. Hedl., GPU, mixed forest, 29 Aug. leg. & det. MRM; deciduous forest, 30 Aug., leg. & det. MRM.

*Hypoxylon fuscum* (Pers.) Fr. on wood of *Corylus avellana* L., GPU, mixed forest, 29 Aug., leg. & det. JS.

*Leptosphaeria* sp. on *Stellaria holostea* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM.

NOTE. The morphology of the fungus is similar to the one described by Mułenko and Kozłowska (2010) who repeatedly collected it in the Białowieża National Park.

*Leveillula taurica* (Lév.) Arnaud, (t), on *Helichrysum arenarium* (L.) Moench, GPU, dune, sand grassland, 30 Aug., leg. & det. MD.

*Melampsora epitea* Thüm. (II, III) on *Salix cinerea* L., KPU, meadow close to Goniądz village, willow thickets, 28 Aug., leg. & det. MRM; on *Salix* sp., GPU, path near dune, 30 Aug., leg. MRM, det. ES; on *Salix viminalis* L., GPU, willow thickets at a roadside, 30 Aug., leg. MD, det. MD & ES.

*Melampsora populnea* (Pers.) Karst. (II, III) on *Populus tremula* L., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Melampsoridium betulinum* (Pers.) Kleb. (II, III) on *Betula pendula* Roth, KPU, T-C, 28 Aug., leg. & det. MRM; on *Betula pubescens* Ehrh., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, V-P, near catwalk, 29 Aug., leg. & det. MRM; same locality, mixed forest, 29 Aug., leg. & det. MRM.



*Melasmia acerina* Lév. on *Acer negundo* L., Osowiec-Twierdza, roadside, 31 Aug., leg. MD, det. ES; on *Acer pseudoplatanus* L., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Melasmia punctata* Sacc. & Roum. on *Acer platanoides* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Melasmia* sp. on *Salix caprea* L., GPU, willow thickets near pathway, 30 Aug., leg. & det. ES.

\**Metasphaeria cumana* (Sacc. & Speg.) Sacc. f. *macrospora* Fautrey on *Carex hirta* L., KPU, mid-forest damp meadow, 28 Aug., leg. & det. MRM.

*Microsphaera divaricata* (Wallr.) Lév. on *Frangula alnus* Mill., (a), KPU, T-C, 28 Aug., leg. & det. MRM; (t), GPU, V-P, 29 Aug., leg. & det. MRM.

*Mycosphaerella epilobii-montani* Lobik on *Epilobium palustre* L., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Mycosphaerella iridis* (Auersw.) J. Schröt. on *Iris pseudoacorus* L., KPU, T-C, 28 Aug., leg. & det. MRM.

NOTE. Species known in a single locality in northeastern Poland (Adamska 2001; Mułenko et al. 2008).

*Mycosphaerella isariphora* (Desm.) Johanson on *Stellaria holostea* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM.

*Mycosphaerella punctiformis* (Pers.) Starbäck on *Quercus petraea* (Matt.) Liebl. x *Q. robur* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM; in anamorphic stage (as *Phyllosticta betulina* Sacc.) on *Betula pubescens* Ehrh., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Nectria cinnabarina* (Tode) Fr. on fallen twigs, KPU, T-C, 28 Aug., leg. & det. MW; on wood of deciduous trees, GPU, mixed forest, 29 Aug., leg. & det. MW.

*Nemania serpens* (Pers.) Gray on fallen branches of deciduous trees, GPU, 29 Aug., leg. & det. JS.

*Neovarysphaera galeopsidis* (DC.) U. Braun [= *Erysiphe galeopsidis* DC.], (a), on *Galeobdolon luteum* Huds., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, mixed forest, 29 Aug., leg. & det. MRM; on *Galeopsis tetrahit* L., KPU, T-C, 28 Aug., leg. & det. MD; GPU, deciduous forest, pathway, 30 Aug., leg. & det. MRM; edge of dune, 30 Aug., leg. & det. MRM.

*Ochropsora ariae* (Fuckel) Ramsb. (II, III) on *Sorbus aucuparia* L. emend. Hedl., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Paraconiothyrium tiliae* (F. Rudolphi) Verkley & Gruyter [= *Asteroma tiliae* F. Rudolphi] on *Tilia cordata* Mill., KPU, T-C, 28 Aug., leg. & det. MRM.

*Passalora campi-silii* (Speg.) U. Braun on *Impatiens noli-tangere* L., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Passalora ferruginea* (Fuck.) U. Braun & Crous on *Artemisia vulgaris* L., KPU, T-C, forest edge, 28 Aug., leg. & det. MD; same locality and date, leg. & det. MRM.

*Passalora microsora* (Sacc.) U. Braun on *Tilia cordata* Mill., GPU, mixed forest, 29 Aug., leg. & det. MRM; GPU, deciduous forest edge, 30 Aug., leg. & det. MRM.

*Peronospora alsinearum* Casp., (a), on *Stellaria media* (L.) Vill., GPU, deciduous forest, glade, 30 Aug., leg. & det. MRM.

*Peronospora sordida* Berk., (a, t), on *Scrophularia nodosa* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Pestalotphaeria* sp. on *Dianthus cartusianorum* L., leg. MRM, det. MRM & ES.

NOTE. So far, no member of the genus has been reported in Poland (Mułenko et al. 2008).

*Phaeosphaeria* sp. on *Sorbus aucuparia* L. emend. Hedl., GPU, deciduous forest, 30 Aug., leg. MRM, det. MRM & ES.

*Phoma glomerata* (Corda) Wollenw. & Hochapfel on *Neoerysiphe galeopsidis* (on *Galeopsis tetrahit*), GPU, edge of dune, 30 Aug., leg. & det. MRM; on *Phyllactinia guttata* (on *Betula pendula*), GPU, edge of dune, 30 Aug., leg. & det. MRM.

*Phragmidium potentillae* (Pers.) P. Karst. on *Potentilla* sp., GPU, dune, sand grassland, 30 Aug., leg. & det. ES.

*Phyllachora graminis* (Pers.) Fuck. on *Poa* sp., KPU, T-C, 28 Aug., leg. & det. MD.

*Phyllactinia guttata* (Wallr.) Lév., (t), on *Betula pendula* Roth, GPU, edge of dune, 30 Aug., leg. & det. MRM.

*Phyllosticta aceris* Saccardo on *Acer negundo* L., Osowiec-Twierdza, roadside, 31 Aug., leg. MD, det. ES.

NOTES. *A. negundo* is a new host for the fungus in Poland (Mułenko et al. 2008).

*Phyllosticta campestris* Pass. on *Acer negundo* L., Osowiec-Twierdza, roadside, 31 Aug., leg. MD, det. ES.

NOTE. *A. negundo* is a new host for the fungus in Poland (Mułenko et al. 2008).

*Phyllosticta cruenta* (Kunze: Fries) Kickx on *Convallaria majalis* L., GPU, T-C, 29 Aug., leg. & det. MD.

*Phyllosticta erysimi* West. on *Alliaria petiolata* (Bieb.) Cavara & Grande, KPU, T-C, 28 Aug., leg. & det. MD.

NOTE. Species known from a single locality in central Poland (Ruskiewicz-Michalska 2006; Mułenko et al. 2008).

*Phyllosticta euonymella* Sacc. on *Euonymus europaea* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Phyllosticta lysimachiae* Allesch. on *Lysimachia vulgaris* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Phyllosticta passerinii* Berl. & Voglino on *Padus avium* Mill., KPU, T-C, 28 Aug., leg. & det. MRM.

*Phyllosticta polygonorum* Sacc. on *Fallopia convolvulus* (L.) Á. Löve, GPU, dune, sand grassland, 30 Aug., leg. MD, det. MRM & ES; on *Polygonum mite* Schrank, KPU, T-C, 28 Aug., leg. & det. MRM.

*Podosphaera balsaminae* (Wallr.) U. Braun & S. Takam. [= *Sphaerotheca balsaminae* (Wallr.) Kari] on *Impatiens noli-tangere* L., (a), KPU, T-C, 28 Aug., leg. ES, det. MD & ES; (t), same locality and date, leg. & det. MRM; on *Impatiens parviflora* DC., KPU, T-C, 28 Aug., leg. & det. MD.

*Podosphaera clandestina* (Wallr.) Lév. var. *aucupariae* (Erikss.) U. Braun, (t), on *Sorbus aucuparia* L. emend. Hedl., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Podosphaera fuliginea* (Schltdl.) U. Braun & S. Takam. [= *Sphaerotheca fuliginea* (Schltdl.) Pollacci], (t), on *Veronica chamaedrys* L., KPU, T-C, 28 Aug., leg. & det. MD.

*Podosphaera myrtilina* (Schubert) Kunze var. *major* Juel, (t), on *Vaccinium uliginosum* L., GPU, V-P, near catwalk, 29 Aug., leg. & det. MRM.

*Podosphaera tridactyla* (Wallr.) de Bary, (t), on *Padus avium* Mill., KPU, T-C, 28 Aug., leg. & det. MRM.

*Podosphaera xanthii* (Castagne) Braun & Schiskoff, (t), on *Melampyrum nemorosum* L., KPU, T-C, 28 Aug., leg. MRM, det. MRM & ES.

*Puccinia arenariae* (Schum.) Wint., (III), on *Melandrium album* (Mill.) Garcke, KPU, T-C, forest edge, 28 Aug., leg. & det. MRM; on *Stellaria media* (L.) Vill., GPU, deciduous forest, glade, 30 Aug., leg. & det. MRM; KPU, T-C, 28 Aug., leg. & det. MRM.

*Puccinia asarina* Kunze, (III), on *Asarum europaeum* L., KPU, T-C, 28 Aug., leg. MD, det. MD & ES; same locality and date, leg. & det. MRM; GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Puccinia chaerophylli* Purton, (II, III), on *Chaerophyllum bulbosum* L. (?), KPU, damp glade with tall herbs, 28 Aug., leg. & det. MRM.

*Puccinia cnici-oleracei* Pers. ex Desm., (III), on *Artemisia vulgaris* L., GPU, dune, sand grassland, 30 Aug., leg. ES, det. MD & ES.

*Puccinia impatientis* Schubad, (II, III), on *Impatiens noli-tangere* L., KPU, T-C, 28 Aug., leg. & det. MD; same locality and date, leg. & det. MRM.

*Puccinia lapsanae* Fuck., (II, III), on *Lapsana communis* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Puccinia polygonii* Alb. et Schw., (II, III), on *Fallopia convolvulus* (L.) Á. Löve, GPU, deciduous forest, 29 Aug., leg. & det. ES; same locality, dune, sand grassland, 30 Aug., leg. & det. MRM; on *Fallopia dumetorum* (L.) Holub, KPU, T-C, 28 Aug., leg. & det. MRM.

*Puccinia punctata* Link, (II), on *Galium sylvaticum* L., GPU, mixed forest, 29 Aug., leg. & det. ES; on *Galium verum* L., KPU, glade with tall herbs, 28 Aug., leg. & det. MRM.

*Puccinia tanacetii* DC., (II, III), on *Artemisia vulgaris* L., Osowiec-Twierdza, roadside, 31 Aug., leg. & det. ES.

*Puccinia violae* DC., (III), on *Viola* sp., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Pucciniastrum agrimoniae* (Dietel) Tranzsch., (II), on *Agrimonia eupatoria* L., KPU, T-C, 28 Aug., leg. & det. MRM.

*Ramularia agrimoniae* Sacc. on *Agrimonia eupatoria* L., KPU, T-C, glade, 28 Aug., leg. & det. MRM.

NOTE. Rare species, known from two localities in eastern and southeastern part of Poland (Wolczańska 2005).

*Ramularia chamaedrys* (Lindr.) Gunnerb. on *Veronica chamaedrys* L., KPU, glade with tall herbs, 28 Aug., leg. & det. MRM.

*Ramularia coleospori* Sacc. on *Coleosporium tussilaginis* (on *Melampyrum nemorosum*), KPU, T-C, 28 Aug., leg. & det. MRM.

*Ramularia grevilleana* (Tul.) Jørst. [= *R. arvensis* Sacc.] on *Potentilla* sp., GPU, dune, sand grassland, 30 Aug., leg. & det. ES.

*Ramularia inaequale* (Preuss) U. Braun on *Hieracium* sp. sect. *Eu-Hieracium*, GPU, dune, sand grassland, 30 Aug., leg. MD, det. MRM & ES.

*Ramularia lapsanae* (Desm.) Sacc. on *Lapsana communis* L., GPU, mixed forest, 29 Aug., leg. & det. ES; same locality and date, leg. & det. MRM.

*Ramularia pratensis* Sacc. on *Rumex* sp., KPU, glade with tall herbs, 28 Aug., leg & det. MRM.

*Ramularia tricheriae* Lindroth on *Knautia arvensis* (L.) Coult, KPU, T-C, glade, 28 Aug., leg. & det. MRM; GPU, dune, sand grassland, 30 Aug., leg. MD, det. MRM & ES.

*Ramularia uredinearum* Hulea on telia of *Puccinia arenariae* (on *Stellaria holostea*), GPU, mixed forest, 30 Aug., leg. & det. MRM.

NOTE. This is the first confirmed collection of the species as the specimens documenting its previous reports do not exist (Wołczańska 2005).

*Ramularia urticae* Ces. on *Urtica dioica* L., KPU, T-C, 28 Aug., leg & det. MRM; GPU, willow thickets, near catwalk, 29 Aug., leg. & det. MRM; same locality and date, leg. & det. ES.

*Ramularia variabilis* Fuckel on *Verbascum nigrum* L., KPU, glade with tall herbs, 28 Aug., leg. & det. MRM.

*Seimatosporium lichenicola* (Corda) Shoemaker & Müll. on *Pyrus communis* L., GPU, dune, sand grassland edge, near the pathway, 30 Aug., leg. MRM, det. MRM & ES.

*Septogloeum carthusianum* (Sacc.) Sacc. on *Euonymus europaea* L., KPU, T-C, 28 Aug., leg. & det. MRM.

NOTE. Species very rare in Poland, known from single report from the Noteć River Valley in NE Poland (Michalski 1982; Mułenko et al. 2008).

*Septoria aegopodii* Desm. ex Kickx on *Aegopodium podagraria* L., GPU, mixed forest, 29 Aug., leg. & det. ES; same locality and date, leg. & det. MRM.

*Septoria betulae* Pass. on *Betula pendula* Roth, GPU, edge of dune, 30 Aug., leg. & det. MRM.

*Septoria chelidoni* (Lib.) Desm. on *Chelidonium majus* L., KPU, T-C, 28 Aug., leg. & det. MRM; GPU, dune, edge of sand grassland, 30 Aug., leg. & det. MD & ES.

*Septoria dulcamarae* Desm. on *Solanum dulcamara* L., GPU, willow thickets, near catwalk,, 29 Aug., leg. & det. MRM.

*Septoria hyperici* Desm. on *Hypericum perforatum* L, KPU, glade with tall herbs, 28 Aug., leg. MRM, det. ES.

*Septoria lychnidis* Desm. on *Melandrium album* (Mill.) Garcke, GPU, dune, edge of sand grassland, 30 Aug., leg. & det. MRM.

*Septoria oenotherae* West. on *Oenothera biennis* L. s.l., GPU, dune, sand grassland, 30 Aug., leg. & det. ES; same locality and date, leg. & det. MRM.

*Septoria polygonorum* Desm. on *Fallopia convolvus* (L.) Á. Löve, GPU, dune, sand grassland, 30 Aug., leg. MD, det. MRM & ES.

*Septoria pyricola* Desm. on *Pyrus communis* L., GPU, dune, sand grassland edge, near the pathway, 30 Aug., leg. MRM, det. ES & MRM.

*Septoria sedi* Westend. on *Sedum telephium* L. (?), GPU, dune, sand grassland, 30 Aug., leg. MRM, det. MRM & ES.

*Septoria virgaureae* (Lib.) Desm. on *Solidago virgaurea* L., GPU, dune, sand grassland, 30 Aug., leg. & det. MD & ES.

*Sphaerellopsis filum* (Biv.) B. Sutton on *Melampsora epitea* (on *Salix cinerea*), KPU, meadow close to Goniądz village, willow thickets, 28 Aug., leg. & det. MRM; (on *Salix viminalis*) GPU, willow thickets at a roadside, 30 Aug., leg. MD, det. ES; on *Puccinia chaerophylli* (on *Chaerophyllum bulbosum*), KPU, damp glade with tall herbs, 28 Aug., leg. & det. MRM; on *Puccinia tanacetii* (on *Artemisia vulgaris*) Osowiec-Twierdza, roadside, 31 Aug., leg. & det. ES.

*Sphaeropsis* sp. on *Dianthus carthusianorum* L., GPU, dune, sand grassland, 30 Aug., leg. & det. MRM.

*Triphragmium ulmariae* (DC.) Link (II, III) on *Filipendula ulmaria* (L.) Maxim., KPU, T-C, edge of damp meadow, 28 Aug., leg. & det. MRM.

*Urocystis syncocca* (Kirchner) Lind. on *Hepatica nobilis* Schreb., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Valdensia heterodoxa* Peyronel on *Betula pubescens* Ehrh., GPU, mixed forest, 29 Aug., leg. & det. MRM.

*Volutella ciliata* (Alb. & Schwein.) Fr. on *Impatiens parviflora* DC., KPU, T-C, roadside, 28 Aug., leg. & det. ES.

NOTE. *I. parviflora* is a new host for the fungus in Poland (Mulenko et al. 2008).

*Xylaria longipes* Nitschke on wood of deciduous trees, GPU, mixed forest, 29 Aug., leg. JS & Dominika Ślusarczyk, det. JS.

*Xylaria polymorpha* (Pers.) Grev. on wood, Osowiec-Twierdza, area of the fortress, 31 Aug., leg. & det. MW.

**Micromycetes associated with arthropods.** In total 15 species of entomopathogenic fungi were found as pathogens of different arthropods and three species were isolated from forest soil or litter by means of the *Galleria* bait method. Six entomophthoralean species from insects and one species from a mite were identified. The most numerous were species from the genus *Zoophthora*. Especially interesting is the second record of mycoses caused by *Zoophthora* sp. 1. in a population of whiteflies (*Aleyrodes* sp. L.) feeding on *Chelidonium majus* L. For the first time we found that the pathogen can infect not only the adults (Tkaczuk et al. 2011a) but also the larval stage of whiteflies. Another fungal species from the genus *Zoophthora* caused heavy epizootics in flies from the family *Lauxanidae* in Kapice and Grzędy protected areas. The morphology of this fungus seems to be very close to *Z. radicans*, but in the light of recent recommendations to verify species identity by molecular markers,

this assumption should be verified. In the course of the study the spider mite *Eotetranychus tiliae* has been identified as a new host for the acaropathogenic fungus *Neozygites floridana*.

From among 11 species of anamorphic Hypocreales (Ascomycota) affecting arthropods in investigated parts of the Biebrza National Park, two have been recognized as pathogens of spiders (*Gibellula leiopus* and *G. pulchra*) and two were pathogenic to mites (*Hirsutella danubiensis* and *H. kirchneri*). *H. danubiensis* is very rare and known only from single localities in Poland and Austria (Bałazy et al. 2008; Tkaczuk et al. 2011a).

*Isaria farinosa* and *I. tenuipes*, representing cordycipitaceous anamorphs, were found as pathogens infecting pupae of unidentified Lepidoptera in the forest litter and soil. In addition, from both aforementioned environments the entomopathogenic fungi *Isaria fumosorosea*, *Metarhizium anisopliae* and *Beauveria bassiana* were isolated by means of the *Galleria* bait method.

***Batkoa apiculata*** (Thaxt.) Humber on unidentified plant-hopper (Homoptera), on the underside of *Corylus avellana* L. leaf, GPU, deciduous forest, 29 Aug., leg. & det. CT.

***Beauveria bassiana*** (Bals.-Criv.) Vuill. on unidentified bug (Heteroptera), GPU, in the litter of deciduous forest, 29 Aug., leg. & det. CT.

***Furia sciarae*** (L.S. Olive) Humber on *Sciaridae* flies, on the underside of leaves of different deciduous trees, GPU, 29 Aug., leg. & det. CT.

***Gibellula leiopus*** (Vuill. ex Maubl.) Mains on spider from the family *Linyphiidae*, on *Corylus avellana* L. leaf, KPU, deciduous forest, 28 Aug., leg. & det. CT.

***Gibellula pulchra*** Cavara on spider from the family *Thomisidae*, GPU, deciduous forest, 29 Aug., leg. JS, det. CT.

***Hirsutella danubiensis*** Tkaczuk, Bałazy & Wegenst. on spider mite *Neotetranychus rubi* (Träg) feeding on *Rubus* sp., KPU, deciduous forest, 28 Aug., leg. & det. CT.

***Hirsutella kirchneri*** (Rostrup) Minter, Brady & Hall on eriophyid mites (*Abacarus* sp.) feeding on grass leaves, KPU, mid-forest clearing, 28 Aug., leg. & det. CT.

***Isaria farinosa*** (Holm) Brown & Smith on unidentified pupa of Lepidoptera, KPU, litter of deciduous forest, 28 Aug., leg. MW, det. CT.

***Isaria fumosorosea*** Wize, isolated from the forest litter by means of *Galleria* bait method, GPU, 29 Aug., leg. & det. CT.

***Isaria tenuipes*** Peck on unidentified pupa of Lepidoptera, KPU, litter of deciduous forest, 28 Aug., leg. Kamil Kędra, det. CT.

***Lecanicillium longisporum*** (Petch) Zare & W. Gams on unidentified plant-hoppers and whiteflies feeding on different herbaceous plants, KPU, deciduous forest, 28 Aug., leg. & det. CT.

***Lecanicillium muscarium*** (Petch) Zare & W. Gams on unidentified aphid, on the underside of *Acer* L. leaf, KPU, deciduous forest, 28 Aug., leg. & det. CT.

***Metarhizium anisopliae*** (Metschn.) Sorokin s.l., isolated from the forest soil by means of *Galleria* bait method, KPU, 28 Aug., leg. & det. CT.

*Neozygites floridana* (J. Weiser & Muma) Remaud. & Keller on spider mite *Eotetranychus tiliae* (Hermann) feeding on *Tilia cordata* Mill. leaves, KPU, 28 Aug., leg. & det. CT.

NOTE. *Eotetranychus tiliae* is a new host for *N. floridana*.

*Zoophthora aphrophorae* (Rostr.) S. Keller on plant-hopper from the genus *Aphrophora* feeding on *Potentilla argentea* L., KPU, 28 Aug., leg. & det. CT.

*Zoophthora* sp. 1. on adults and larvae of whiteflies of the genus *Aleyrodes* L. feeding on *Chelidonium majus* L., KPU, deciduous forest, 28 Aug., leg. & det. CT.

NOTE. Species known in Poland from one locality (Tkaczuk et al. 2011a).

*Zoophthora* sp. 2. on *Lauxaniidae* flies on the underside of leaves of different deciduous trees, KPU, 28 Aug., leg. & det. CT; GPU, 29 Aug., leg. & det. CT.

**Fungi isolated from soil and organic matter.** In total 36 species of saprotrophic fungi were identified as a result of 33 plate analyses. 15 of them were prepared with the Warcup method, 10 with Gammari and shrimps baits, six plates with the dilution technique and two plates were filled with the excrement of wild animals. Only one species, *Mucor hiemalis*, was revealed in samples from several localities. *Kickxella alabastrina*, a very rare species in Poland, was observed only once, caught on a *Gammarus* bait. It is worth noting that usually Kickxellales members develop on a single bait unit, despite the regular arrangement of baits on soil entirely filling the plate. They are absent when the plate dilution method is used. The Warcup method allows their disclosure, but they grow always from separate soil particles, which could be identified as insect excrement or insect remnants (Kurihara 2006).

*Absidia caerulea* Bainier, obtained with Warcup method, KPU, deciduous forest, 28 Aug., leg. & det. MW; WPU, „Carska Droga”, at road edge, spruce forest, 01 Sept., leg. & det. MW.

*Absidia glauca* Hagem, obtained with Warcup method, WPU, „Carska Droga”, at road edge, birch forest, 01 Sept., leg. & det. MW.

*Absidia repens* Tiegh. s.l., obtained with Warcup method, GPU, dune, sand grassland, 30 Aug., leg. & det. MW.

*Aspergillus candidus* Link on roe deer excrement, KPU, T-C, 28 Aug., leg. & det. MW.

*Cladosporium cladosporioides* (Fresen.) de Vries, obtained with Warcup method, WPU, Barwik, peatbog, 31 Aug., leg. & det. MW.

\**Clonostachys solani* f. *solani* (Harting) Schroers & W. Gams on roe deer excrement, GPU, mixed forest, 29 Aug., leg. & det. MW.

*Coemansia* sp., obtained with Warcup method, KPU, T-C, 28 Aug., leg. & det. MW.

NOTE. The species could not be identified with use of Skirgiello and Zadara's monograph (1979), nor with papers by Kurihara et al. (2000, 2001, 2004, 2006, 2008).

*Cunninghamella elegans* Lendn., obtained with Warcup method, GPU, dune, sand grassland, 30 Aug., leg. & det. MW.

*Dictyostelium mucoroides* Bref., obtained with Warcup method, WPU, „Carska Droga”, at road edge, spruce forest, 01 Sept., leg. & det. MW.

*Kickxella alabastrina* Coem., obtained with bait method, isolated on *Gammarus*, KPU, deciduous forest, 28 Aug., leg. & det. MW.

*Lentamyces parvicida* (Renner & Muskat ex Hesselt. & J.J. Ellis) Kerst., Hoffmann & K. Voigt, obtained with Warcup method, KPU, deciduous forest, 28 Aug., *leg. & det. MW*.

\**Mariannaea elegans* (Corda) Samson on spruce twig, KPU, mixed forest, 28 Aug., *leg. MW, det. Mateusz Wilk*.

*Mortierella bainieri* Costantin, obtained with bait method, isolated on *Gammarus*, WPU, „Carska Droga”, at road edge, spruce forest, 01 Sept., *leg. & det. MW*.

*Mortierella bisporalis* (Thaxter) Björling, obtained with bait method and observed directly on soil and plant remnants, KPU, deciduous forest, 28 Aug., *leg. & det. MW*.

*Mortierella polycephala* Coem., obtained with bait method, observed directly on soil and plant remnants, WPU, mixed forest, 31 Aug., *leg. & det. MW*.

*Mortierella zychnae* Linnem., obtained with bait method, isolated on *Gammarus* and observed directly on soil and plant remnants, WPU, mixed forest, 31 Aug., *leg. & det. MW*.

*Mucor fragilis* Bainier, obtained twice with bait method, isolated on *Gammarus*, WPU, „Carska Droga”, at road edge, under wooden tower and from meadow soil, 01 Sept., *leg. & det. MW*.

*Mucor hiemalis* Wehmer, obtained with bait method and plate dilution method, GPU, alder fen forest, 30 Aug., *leg. & det. MW*; dune, 30 Aug., *leg. & det. MW*; WPU, „Długa Luka” educational path, meadow soil, 01 Sept., *leg. & det. MW*.

*Mucor mucedo* L., obtained with Warcup and bait methods, isolated on *Gammarus*, WPU, mixed forest, isolated from the forest litter, 31 Aug., *leg. & det. MW*.

*Mucor plumbeus* (Bonord) Arx, obtained with Warcup method, WPU, „Carska Droga”, at road edge, birch forest, 28 Aug., *leg. & det. MW*.

*Mucor saturninus* Hagem, obtained with Warcup method, GPU, dune, 30 Aug., *leg. & det. MW*.

*Penicillium commune* Thom, obtained with Warcup method, WPU, „Carska Droga”, road edge, twice, from birch and spruce forests, 01 Sept., *leg. & det. MW*.

*Pilaira anomala* (Ces.) J. Schröt., obtained with Warcup method, KPU, T-C, 28 Aug., *leg. & det. MW*.

NOTE. The fungus grew directly from soil particles, possibly from animal excrement.

*Pilobolus crystallinus* Klein. on wild boar excrement, Osowiec-Twierdza, 31 Aug., *leg. & det. MW*.

*Piptocephalis lepidula* (Marchal) R.K. Benj., obtained with Warcup method and with plate dilution method, WPU, „Długa Luka” educational path, meadow soil, 01 Sept., *leg. & det. MW*.

*Piptocephalis* sp., obtained with bait method, from soil particles, WPU, „Carska Droga”, at road edge, spruce forest, 01 Sept., *leg. & det. MW*.

NOTE. This species with very thin branches and moist sporocladial heads has already been found several times in BbNP (Boulahdjel 2010).

*Rhizopus oryzae* Went & Prins. Geerl., obtained with Warcup method, WPU, „Długa Luka” educational path, meadow soil, 01 Sept., *leg. & det. MW*.



*Rhizopus stolonifer* (Ehrenb.) Vuill., obtained with Warcup method, WPU, peatbog, 31 Aug., leg. & det. MW.

*Stilbella* sp., directly on roe deer excrement, KPU, T-C, 28 Aug., leg. & det. MW.

*Syncephalis penicillata* Indoh., obtained with bait method, WPU, „Długa Luka” educational path, meadow soil, 01 Sept., leg. & det. MW.

*Syncephalis sphaerica* Tiegh., obtained with Warcup method and with bait method, WPU, Barwik, meadow soil, 31 Aug., leg. & det. MW.

*Syncephalis tenuis* Thaxter, obtained with bait method, WPU, Barwik, meadow soil, 31 Aug., leg. & det. MW.

*Trichoderma koningii* Oudem., obtained with Warcup method, KPU, T-C, 28 Aug., leg. & det. MW; WPU, peatbog, 31 Aug., leg. & det. MW.

*Trichoderma viride* Pers., obtained with Warcup method, and with plate dilution method, WPU, “Carska Droga”, at road edge, birch forest, 01 Sept., leg. & det. MW.

*Umbelopsis isabellina* (Oudem.) W. Gams, obtained with Warcup method, GPU, mixed forest, 29 Aug., leg. & det. MW.

*Umbelopsis ramanniana* (Möller) Gams, obtained with Warcup method, KPU, T-C, 28 Aug., leg. & det. MW.

## FINAL REMARKS

The first, short-term and area-limited inventory of fungi occurring in the BbNP has yielded a relatively high number of fungi taxa. The ratio infected plants/parasitic fungi observed currently is also rather high, reaching 1:0.7 (cf. analysis by Mułenko 1998, Tab. 2). The presented results of our studies, although preliminary, give valuable information on the microfungi of the BbNP. The species' richness and taxonomic diversity of the determined fungi, together with a number of yet unidentified specimens, is promising for future studies in the protected area of the Biebrza Valley.

Key outcomes:

- The initiation of mycological studies in the BbNP, the area that until now had very fragmented information on the fungi present, comprising mainly species belonging to macromycetes and soil-inhabiting taxa. As a result of the study, basic ecological data on 188 micromycete taxa, classified in 17 orders and a group of anamorphic fungi, occurring in the area have been gathered.
- Reports of 128 taxa associated with plants, 17 species of arthropod pathogens, 12 species of soil fungi and 7 species of fungicolous fungi that are new to the mycobiota of the BbNP.
- Four species new in Polish mycobiota (e.g., *Alternaria nobilis*, *Clonostachys solani*, *Mariannaea elegans*, *Metasphaeria cumana*) and 17 taxa very rarely recorded in Poland, e.g., *Asteromella eupatoriicola*, *Asteroma padi*, *Cercospora berteroa*, *Discosia minuta*, *Ectostroma iridis*, *Exobasidium rostrupii*, *Fusicladium scribnerianum*, *Hirsutella danubiensis*, *Kickxella alabastrina*, *Mycosphaerella*

*iridis*, *Paraconiothyrium tiliae*, *Phyllosticta aceris*, *P. erysimi*, *Ramularia agrimoniae*, *R. uredinearum*, *Septogloeum carthusianum*, *Volutella ciliata*, *Zoophthora* sp. 1.

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## Wstępne badania grzybów w Biebrzańskim Parku Narodowym. I. Grzyby mikroskopijne

### Streszczenie

Prezentowane dane są wynikiem badań prowadzonych w dniach od 28 sierpnia do 1 września 2012 w ramach sesji terenowej Polskiego Towarzystwa Mykologicznego. Celem była wstępna inwentaryzacja grzybów i śluzowców występujących na terenie Biebrzańskiego Parku Narodowego (BbPN). W artykule krótko podsumowano uzyskane wyniki, prezentowane w postaci adnotowanego wykazu 188 taksonów mikroskopijnej wielkości grzybów właściwych (33 gatunki grzybów sprzężniowych, 130 workowych i anamorficzych, 22 podstawkowe) oraz trzech gatunków zaliczanych do organizmów grzybopodobnych (*Peronospora alsinearum* i *P. sordida* z Chromista oraz *Dictyostelium mucoroides* z Protozoa). Ogółem zidentyfikowano 128 gatunków związanych troficznie z roślinami, 17 ze stawonogami i 7 z grzybami oraz 36 gatunków grzybów wyizolowanych z gleby i szczątków organicznych. 89% wszystkich gatunków podano z terenu parku po raz pierwszy. Wśród znalezionych grzybów są gatunki bardzo rzadko notowane (znane z 1-2 stanowisk) i cztery stwierdzone w Polsce po raz pierwszy: *Alternaria nobilis*, *Clonostachys solani*, *Mariannaea elegans* i *Metasphaeria cumana*. Pozostałe, nieuwzględnione tu gatunki mikromycetes nowe dla bioty Polski będą scharakteryzowane w odrębnych artykułach. Wyniki dotyczące makromycetes prezentowane są w części drugiej opracowania (Kujawa et al. 2012).

Badania przeprowadzone w BbPN rozpoczynają planowany wieloletni cykl inwentaryzacji w obiektach chronionych, nieposiadających danych mykologicznych. Celem tych badań jest uzyskanie danych będących podstawą do poznania biologii wielu gatunków, w tym ich reakcji na presję człowieka. Wiedza ta jest niezbędna zarówno do poznania roli grzybów mikroskopijnych w funkcjonowaniu obszarów chronionych i określenia zagrożeń jakim podlegają same grzyby, jak i do uświadomienia społeczeństwu konieczności ich ochrony na równi z innymi organizmami.