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Macromycetes diversity of pine-tree plantings on a post-fire forest site in Notecka Forest (NW Poland)

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The article presents the results of a study on fungi in pine-tree plantings after the last great fire in Notecka Forest. The occurrence of 134 species of fungi and 3 species of myxomycetes was recorded in 25 permanent study areas investigated between 1993 and 1998. The participation of bio-ecological groups of macromycetes was described in the context of vegetation changes in the years following the fire.

Key words: burnt forests, pyrophilous fungi, succession, *Spergulo morisonii-Corynephoretum canescentis*, Notecka Forest

INTRODUCTION

Burnt forests are the habitats in which a parallel succession of vegetation and macroscopic fungi occurs at a relatively high rate in the first years following a fire. The problem of fungal succession was examined by authors such as Termorshuizen (1991), Kałucka and Sumorok (1996), Kałucka (1998), Sumorok (1998, 2001). Vegetation succession in abandoned farmlands, released from a long-lasting human impact, was studied by Faliński (1986), and the succession of vegetation in burnt forests by Parusel (1998).

A special group of pyrophilous fungi develops on charred wood or burnt-out soil. Various aspects of research on pyrophilous fungi, also in the area of Poland, were presented in several studies (Turnau 1984; Ginko 1984; Kałucka and Sumorok 1996; Dyląg and Gumińska 1997; Sumorok 1998, 2001). Individual species of antracophilous fungi are given in most studies on macromycetes. Ebert (1999) gives a bibliography survey of mycological research on pyrophilous fungi over the last century in Europe.

The subject of this paper is macroscopic fungi in pine-tree plantings in a burnt pine forest in the context of secondary vegetation succession.

STUDY AREA

The study area is situated in the north-eastern part of Notecka Forest, also called Nadnotecka Forest or Notecko-Warciańska Forest, between the villages of Krzyż and Wronki. It is a part of the macroregion of the Toruńsko-Eberswaldzka proglacial valley, mesoregion of the Gorzowska Valley, submesoregion of the Lower Noteć Valley (K o n d r a c k i 1998). In terms of geobotany, it is Wielkopolsko-Kujawska area, Notecki region (S z a f e r 1972).

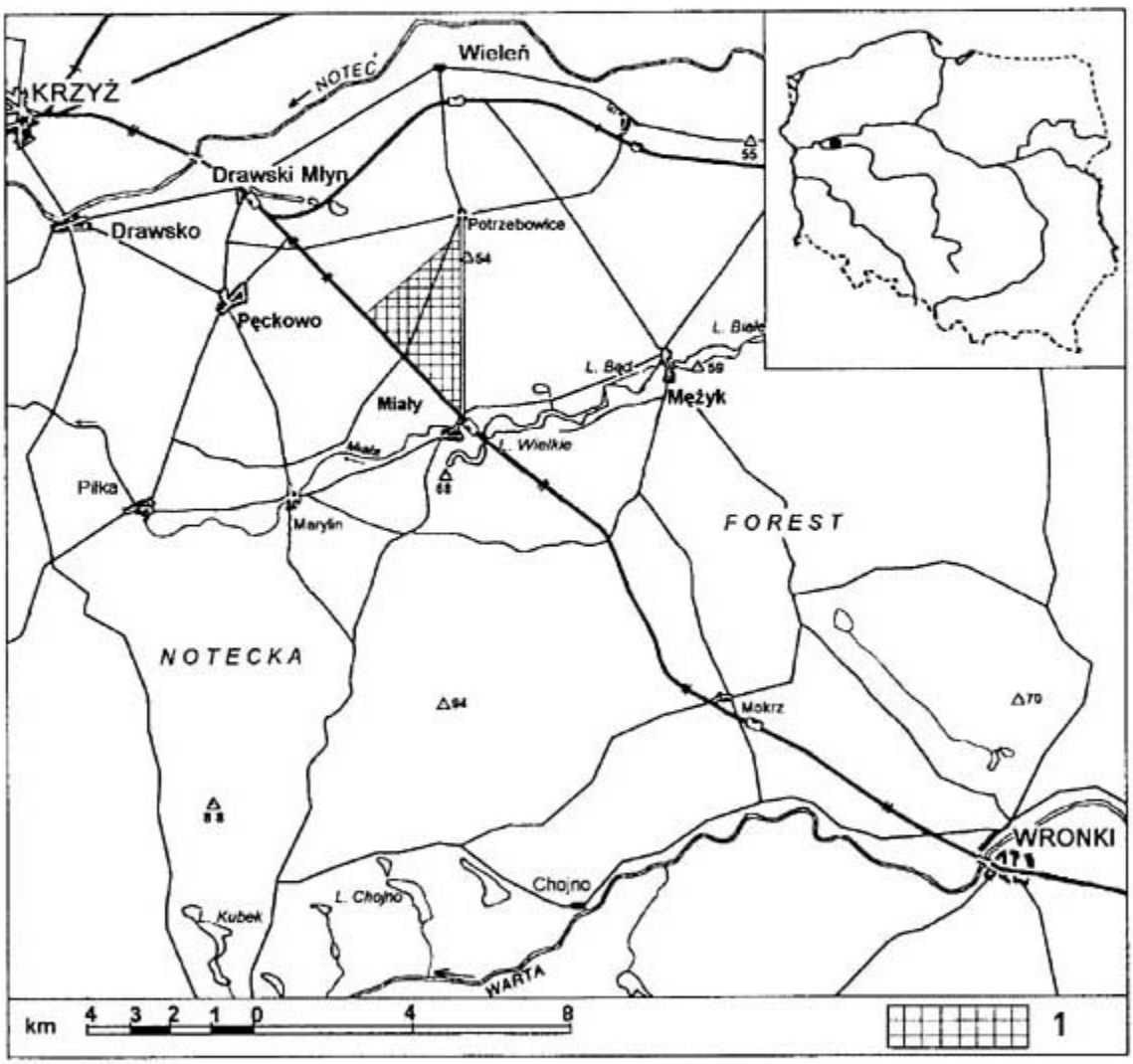

Fig. 1. Location of the study area in Notecka Forest. 1 — study area.

The studied area of Notecka Forest is homogenous from the point of view of physiography, both as regards landscape formation and forest vegetation. The landscape is fluvioglacial, flat, rolling or rolling and hilly, with hills and

dune hills in its southern part (L e c i e j e w s k i 1997). The area is overgrown with pine monocultures. The landscape is diversified by valleys of the river Noteć and the valley of the river Miała, parallel to it, which connects a number of shallow, strongly overgrowing lakes. The rivers have a beneficial influence on the local climate and water conditions.

Ochriarenosols and podsols, formed on fine-grained loose sands, prevail. Sands come from the Wrm glaciation of the Poznań stage. The pH of the genetic level of these soils is low and equals 3.15–4.0, and for deeper layers – 3.95–4.75.

In G u m i ń s k i ' s (1948) division of farming and climatic districts of Poland, the study area was included in the Nadnotecka district, characterised by the mean annual temperature 80C, mean temperature in January – 2.3°C and in July – 17.4°C.

The vegetative period here lasts 205–215 days (L e c i e j e w s k i 1997). The average annual rainfall between 1937 and 1960 was 650–700 mm, and over the last 40 years – 490–550 mm.

Water relationships are rain-related. The level of ground waters has been decreasing steadily, and fell down by ca. 2 m between 1881 and 1961. In the decade preceding the fire, i.e. between 1982 and 1992, the level decreased by further 1.5 to 2 m and currently can be found at the depth of 10–20 m.

Fresh pine forest habitats occur in the majority of the area, while dry pine forest habitats occur to a smaller extent. Other habitats cover small areas. At the moment, forest stands aged 60–70 years take up up to 75% of Notecka Forest. Large areas of complexes of pine monocultures, the economy of clear cutting in large areas practised for nearly two centuries, as well as an artificial method of forest restocking, mainly with pine, bring about the threat of insect pests, pathogenic fungi and climate factors, such as snow brows or hurricanes.

Between 1922 and 1925, the greatest gradation of pine noctuids in Europe occurred in Notecka Forest, as a result of which ca. 75 thousand ha of the forest were felled and its restocking took nearly 20 years. A gradation of nun moths took place between 1979 and 1983. Weakened forest stands were attacked by secondary pests and fungi, as a result of which over 5 m^3 of large timber were removed in the process of total and sanitary fellings. It has been observed that gradations of insect pests have been becoming more frequent and the periods between them shorter over the last 50 years or so (T o m c z y k 1997).

Fires constitute one more constant threat for Notecka Forest. The average annual number of fires was ca. 160 over the last five years. The largest of them in the last 50 years took place in the Potrzebowice forest inspectorate in 1992. Approximately 400 ha of the forest south of the village Miały burnt down in a fire which started on 2nd June, and almost 5 thousand ha of the forest between the villages of Potrzebowice and Miały on 10th August (T o m c z y k 1997). The fire started in the vicinity of the Krzyż-Poznań railway tracks at 4.30 p.m. and spread so quickly that the villages of Potrzebowice,

Miały and Mężyk were endangered. The line of fire crossed the river Miała at midnight. The fire was put out by a storm accompanied by a very heavy rain that started at 12.24 a.m. and lasted until 2.46 a.m. 29.1 mm of water fell down in that span of time. It was an upper type of fire, a so-called crown fire (Rabotonow 1985; Podbielkowski and Podbielkowska 1992), in which the lower layers of vegetation and leaf litter were burnt out, and trees were burnt. The fire led to a complete destruction of the forest.

Damage removal works, i.e. tree felling and processing of burnt trees, took 11 months, and nearly one million m^3 of large timber was obtained. Branches, crowns and other post-felling parts were piled up, shredded and left on the site. Restocking works lasted three years, and plantings had to be carried out again in large areas where the works had failed. A so-called "pro-ecological forest model" was applied for forest restitution, and its composition was adjusted to the habitat, high quality planting material was used, tens of kilometres of biological fire protection belts were made and several fire stations with the area of 0.20 ha were set up (Tomczyk 1997).

METHODS

The study area belongs to the Potrzebowice forest inspectorate and comprises the area between the villages of Potrzebowice and Miały (Fig. 1). Observations, still carried out, commenced one year after the fire, that is in 1993. They are conducted in pine-tree plantings, in a pine thicket and in a pine forest *Peucedano-Pinetum*. The results of the first stage of the examination of fungal succession in pine-tree plantings comprising the years between 1993 and 1998 were presented earlier. Observations were carried out eight times per year on the average, more often in autumn.

Investigations presented in this paper were conducted in 25 permanent plots, 400 m^2 big, delineated in pine-tree plantings. Bio-ecological groups of fungi and types of substrates on which they developed were analysed. Abundance of fruit-bodies was assessed on Moser's quantity scale (1949). A list of fungi together with the quantity degree, obtained during the annual observations carried out in one area, is shown in a mycosociological relevé.

A phytosociological relevés of permanent areas, prepared with the Braun-Blanquet (1964) method, were made every year since 1994, mainly in June and July, and quantity scales were expanded to include bryophytes (Altrock 1987; Härdtle 1987). The nomenclature of vascular plants was accepted after Mirek et al. (1995), of bryophytes after Corley et al. (1981), and of fungi after Hansen and Knudsen (1992, 1997), Kreisel (1987), Krieglsteiner (1991). Syntaxonomic nomenclature and phytocoenotic rank of species was based on the studies by Matuszkiewicz (1981) and Czyżewska (1992).

Phytosociological relevés as well as mycological observation made in individual years in all areas investigated were grouped together in tables and

constancy was assessed. Due to large volume, the tables are not included in this paper. On their basis, comprehensive tables for plants (Table 1) and for fungi (Table 2) presenting the occurrence of individual species in the course of time following the fire were prepared to analyse succession. The constancy degree in a given year for each species (Roman numerals) and the range of quantity degree (Arabic numeral) achieved by the species in that period were given. Only for species producing persistent fruit-bodies the degree of phytosociological constancy was given.

DESCRIPTION OF VEGETATION

Conditions for plant development in the vast post-fire area were first unfavourable after the burnt-down and burnt wood had been removed. Strong winds dried up upper layers of soil and blew out organic substances and ash. Thus, these habitats are low in nutrients. Large areas of loose sands were exposed and were later removed by winds and blown over the furrows with pine-tree seedlings. The same effect was brought about by heavy rains in 1993. As a result, approximately 90% of the plantings had to be carried out again. For the purposes of protection, deciduous trees, mainly birch *Betula pendula* and grey alder *Alnus incana*, were planted in pine-tree plantings.

Plant species characteristic of the *Sedo-Scleranthetea* class appeared in the first year after the fire. Occupancy occurred mainly in the furrows between pines, while pine rows grew over later on and their stand density was small. Psammophilous grassland *Spergulo morisonii-Corynephoretum canescentis* (Table 1) developed over the next years. It is the initial stage of the grassland with a typical physiognomy, formed by the association of pioneer xerophytes that colonise moving sands in the most effective way. Terrophytes *Spergula morisonii* and *Teesdalea nudicaulis* and hemicryptophyte *Corynephorus canescens* were the species that showed great expansive tendencies in the process of forming the community of the field layer. In the ground layer, however, chamephytes *Polytrichum piliferum* and *Ceratodon purpureus* are of great phytocoenotic and quantitative importance. Due to the species composition and a loose or very loose type of the grassland, it can be classified as a typical *Spergulo morisonii-Corynphoretum canescentis typicum* subassociation (C z y ż e w s k a 1992). Of other characteristic species of *Sedo-Sceranthetea*, a greater role is played by *Hieracium pilosella* and *Rumex acetosella* in the first years after the fire and by *Festuca ovina* later on. Constancy and coverage were high in the case of species of the class *Epilobietea angustiofolii* — *Chamaerion angustiofolium* and *Calamagrostis epigejos*, which very often occur in burnt forests and clearings (R a b o t o n o w 1985). *Chamaenerion angustiofolium* is a taxon that can colonise burnt forests quickly, spreading generatively and vegetatively very well. Characteristic species of the *Nardo-Callunetea* class co-occur with the taxa given above. These are first of all: *Carex ericetorum, Calluna vulgaris* and *Luzula multiflora*. The participation of *Carex ericetorum,*

Table 1
Vegetation of pine plantings on the site of a fire in Notecka Forest

Years	1993	1994	1995	1996	1997	1998
Year after the fire	1	2	3	4	5	6
Number of records	15	20	25	25	25	25
Number of species 82	19	35	47	40	53	41
1	2	3	4	5	6	7
Pinus sylvestris b	IV_{+-1}	V_{2}	V_{2}	V_{1-4}	V_{2-3}	V_{2-4}
Betula pendula b	III_{+}	IV_{+-1}	V_{1-2}	V_{+-3}	V_{1-3}	V_{+-4}
Alnus incana b	.	IV_{+-1}	II_{+-1}	II_{+}	IV_{+-2}	IV_{+-2}
Sedo-Scleranthetea						
Polytrichum piliferum d	I_{1-2m}	I_{1-2m}	II_{1-2m}	V_{2m-3}	V_{2m-3}	V_{2m-3}
Hieracium pilosella	III_{+}	III_{+-1}	IV_{+-1}	V_{+-1}	IV_{+-1}	II_{+}
Spergula morisonii	IV_{1-2}	V_{2}	V_{3-4}	II_{1-3}	III_{1-2}	IV_{+-3}
Rumex acetosella	III_{+}	IV_{+-1}	V_{+-2}	III_{+-1}	III_{+-1}	.
Ceratodon purpureus d	III_{2m}	IV_{2m}	.	I_{2m}	IV_{2m-2b}	V_{2m-3}
Corynephorus canescens	.	II_{+-2}	V_{+-4}	V_{+-4}	V_{1-4}	V_{1-4}
Teesdalea nudicaulis	.	II_{+}	III_{+}	II_{+}	II_{+}	.
Scleranthus perennis	.	I_{+}	I_{+}	I_{+}	I_{+}	.
Cerastium semidecandrum	.	I_{+}	I_{+}	.	I_{+}	.
Artemisia campestris	.	.	I_{+}	I_{+}	.	.
Trifolium arvense	.	.	I_{+}	.	I_{+}	.
Festuca ovina	.	.	.	I_{+}	IV_{+-1}	II_{+-2}
Jasione montana	.	.	.	II_{+}	I_{+}	I_{+}
Potentilla argentea	.	.	.	II_{+}	.	.
Nardo-Callunetea						
Carex ericetorum	I_{+}	II_{+}	V_{+-1}	IV_{+-2}	V_{+-2}	V_{+-2}
Calluna vulgaris	.	II_{+-1}	V_{+-1}	V_{+-2}	V_{+-2}	IV_{+-2}
Luzula multiflora	.	I_{+}	III_{+}	I_{+}	II_{+}	I_{+}
Luzula campestris	.	I_{+}	I_{+}	.	I_{+}	.
Peucedanum oreoselinum	.	.	I_{+}	I_{+}	I_{+}	II_{+}
Carex pilulifera	.	.	II_{+-1}	II_{+-1}	.	I_{+}
Arctostaphylos uva-ursi	.	.	.	.	.	II_{+}
Epilobietea angustifolii						
Chamaenerion angustifolium	III_{+-1}	III_{+-2}	III_{1-2}	V_{+-2}	IV_{+-2}	III_{+-2}
Calamagrostis epigejos	I_{+}	II_{+}	III_{+-2}	II_{+-2}	IV_{+-2}	IV_{+-2}
Senecio sylvaticus	II_{+-1}	I_{1}	.	.	III_{+-2}	.
Verbascum nigrum	.	.	I_{+}	I_{+}	.	.
Accompanied species						
Conyza canadensis	III_{+}	III_{+}	III_{+-1}	III_{+-1}	III_{+-1}	.
Taraxacum officinale	II_{+-2}	II_{+-1}	II_{+}	II_{+}	.	.
Senecio viscosus	II_{+-1}	I_{+}	I_{+}	.	II_{+-1}	.
Hypochoeris radicata	I_{+}	I_{+}	I_{+}	.	II_{+}	.
Funaria hygrometrica d	III_{1-2m}	II_{2m-2b}	.	.	.	.
Veronica arvensis	II_{+}	I_{+}	.	.	.	.
Polygonum aviculare	I_{+}	.	.	.	.	.
Solidago canadensis	I_{+}	.	.	.	.	.
Deschampsia flexuosa	.	I_{+}	II_{+-2}	III_{+-2}	V_{+-2}	V_{+-2}
Agrostis capillaris	.	I_{+}	I_{+}	II_{+}	V_{+-1}	V_{+-2}
Populus tremula b	.	I_{+-1}	IV_{+-3}	.	II_{+}	II_{+}
Senecio vernalis	.	II_{+}	IV_{+}	II_{+}	.	.

Hypericum perforatum	.	I_+	I_+	.	I_+	II_{+-1}
Holcus mollis	.	I_+	I_+	I_+	.	.
Viola arvensis	.	I_+	I_+	I_+	.	.
Oxalis acetosella	.	I_+	I_+	.	.	.
Plantago arenaria	.	I_+	I_+	.	.	.
Lepidium ruderale	.	I_+	.	I_+	.	.
Veronica officinalis	.	.	III_+	I_+	III_{+-1}	III_{+-2}
Betula pubescens b/c	.	.	I_+	II_+	I_+	II_{+-1}
Euphorbia cyparissias	.	.	II_+	I_+	I_+	I_+
Populus nigra b/c	.	.	I_+	II_+	II_+	.
Carex hirta	.	.	II_+	.	I_+	.
Scorzonera humilis	.	.	I_+	.	.	I_+
Juncus effusus	.	.	I_+	I_+	.	.
Artemisia absinthium	.	.	I_+	.	.	.
Carex leporina	.	.	I_+	.	.	.
Linaria vulgaris	.	.	I_+	.	.	.
Lotus corniculatus	.	.	I_+	.	.	.
Rumex acetosa	.	.	I_+	.	.	.
Polytrichum juniperinum d	.	.	.	IV_{2m-3}	III_{2m-3}	II_{2m-3}
Padus serotina b/c	.	.	.	I_+	I_+	II_+
Arabidopsis thaliana	.	.	.	I_{+-1}	I_+	.
Oenothera biennis	.	.	.	I_+	.	.
Vaccinium vitis-idaea	.	.	.	.	III_{+-1}	IV_{+-2}
Genista tinctoria	.	.	.	.	II_+	II_{+-1}
Festuca rubra	.	.	.	.	I_+	II_{+-2}
Sorbus aucuparia b/c	.	.	.	.	I_{+-1}	I_+
Galium verum	.	.	.	.	I_+	I_{+-1}
Anthoxanthum odoratum	.	.	.	.	I_+	I_+
Quercus robur b/c	.	.	.	.	I_+	I_+
Salix caprea b/c	.	.	.	.	I_+	I_+
Pohlia sp. d	.	.	.	.	I_{2m}	.
Agrostis stolonifera	.	.	.	.	I_+	.
Anthericum ramosum	.	.	.	.	I_+	.
Helichrysum arenarium	.	.	.	.	I_+	.
Herniaria glabra	.	.	.	.	I_+	.
Luzula nemorosa	.	.	.	.	I_+	.
Potentilla arenaria	.	.	.	.	I_+	.
Campanula rotundifolia	.	.	.	.	.	I_+
Pimpinella saxifraga	.	.	.	.	.	I_+
Polygonatum odoratum	.	.	.	.	.	I_+
Viola canina	.	.	.	.	.	I_+
Viola reichenbachiana	.	.	.	.	.	I_+

Table 2

Occurrence of macromycetes in pine plantings in burnt forest in the years after the fire

Years	1993	1994	1995	1996	1997	1998	Trophic
Year after the fire	1	2	3	4	5	6	Groups/
Number of species	12	24	44	87	73	70	Substrate
1	2	3	4	5	6	7	8
Hypholoma fasciculare (Huds.: Fr.) Kumm.	I_{1-2}	II_{1-2}	IV_{2-3}	V_{3-5}	IV_{3-5}	IV_{2-4}	S/w
Fuligo septica Gmelin	II_{+}	II_{+-1}	I_{+}	II_{+-1}	II_{+-1}	III_{+-1}	S/w
Armillaria mellea (Vahl.: Fr.) Kumm. s. l.	I_{1-2}	I_{1-2}	II_{1-2}	II_{1-2}	II_{1-2}	I_{1-2}	S/w
Schizophyllum commune Fr. : Fr.	I_{2}	II_{2}	.	III_{1-3}	II_{2}	I_{2}	S/w
Trichaptum hollii (J. C. Schmidt: Fr.) Kreis.	I	.	I	V	IV	II	S/w
Tricholomopsis rutilans (Schaeff.: Fr.) Sing.	I_{1}	.	I_{1}	IV_{1-2}	II_{+-1}	III_{1-2}	S/w
Piptoporus betulinus (Bull.: Fr.) P. Karst.	I	.	I	I	I	I	S/w
Pholiota carbonaria (Fr.) Sing.	V_{1-5}	V_{3-5}	IV_{4-5}	IV_{1-3}	.	.	S/w
Rhizina undulata Fr.	V_{3-5}	IV_{3-4}	III_{1-2}	.	I_{+-1}	.	S/s
Tephrocybe anthracophila (Lasch) Orton	II_{+-1}	II_{+-2}	.	I_{1}	I_{+-2}	.	S/w
Tephrocybe atrata (Fr.: Fr.) Donk	II_{+-2}	.	I_{1-2}	IV_{+-2}	I_{+-1}	.	S/w
Plicaria leiocarpa (Currey) Boud.	II_{1-3}	I_{1-2}	I_{2}	.	.	.	S/w
Thelephora terrestris Ehrh. ex Willd.: Fr.	.	II_{1-2}	III_{2-3}	V_{3-5}	V_{3-5}	V_{2-5}	M/s
Pholiota astragalina (Fr.) Sing.	.	II_{+-2}	III_{+-2}	V_{+-3}	IV_{+-2}	V_{+-2}	S/w
Laccaria proxima (Boud.) Pat.	.	II_{1-2}	II_{1-3}	V_{2-4}	II_{+-2}	II_{+-2}	M/s
Gymnopilus hybridus (Fr.: Fr.) Sing.	.	II_{+-1}	III_{+-2}	IV_{1-4}	III_{+-2}	III_{+-1}	S/w
Lycogala epidendrum Fr.	.	III_{2}	III_{1-2}	III_{2-3}	II_{1-2}	I_{1-2}	S/w
Coltricia perennis (L.: Fr.) Murrill	.	I_{+-1}	I_{+-1}	III_{+-1}	V_{+-2}	I_{+-1}	S/s
Calocera furcata (Fr.) Fr.	.	I_{2}	II_{2}	I_{2}	II_{2-3}	II_{2}	S/w
Dacryomyces stillatus Nees: Fr.	.	I_{2}	I_{2}	I_{2-3}	II_{2-5}	I_{1-2}	S/w
Reticularia lycoperdon Bull.	.	II_{+-1}	I_{+}	II_{+-1}	.	II_{+-1}	S/w
Psilocybe crobula (Fr.) M. Lge. ex Sing.	.	II_{+-2}	II_{1-2}	II_{+-2}	.	.	S/s
Hypholoma sublateritium (Fr.) Quél.	.	I_{1}	I_{1-2}	.	I_{1-2}	.	S/w

Tab. 2 cont.

1	2	3	4	5	6	7	8
Rickenella fibula (Bull.: Fr.) Raith.	.	I_{+-1}	.	III_{+-2}	I_{+-2}	.	S/s,m
Polyporus brumalis (Pers.): Fr.	.	I_{+-1}	.	I_{+}	I_{+-1}	.	S/w
Myxomphalia maura (Fr.) Hora	.	II_{+-2}	II_{+-2}	.	.	.	S/w
Tephrocybe ambusta (Fr.: Fr.) Donk	.	II_{+-2}	.	.	I_{1-2}	.	S/w
Botryobasidium sp.	.	I	.	.	.	.	S/w
Laccaria laccata (Scop.: Fr.) Bk. et Br.	.	.	III_{2-3}	V_{2-5}	V_{1-4}	III_{+-2}	M/s
Hygrophoropsis aurantiaca (Wulf.: Fr.) R. Mre.	.	.	II_{+-1}	V_{+-4}	I_{1}	I_{1-2}	S/s
Paxillus involutus (Batsch: Fr.) Fr.	.	.	I_{+-1}	III_{+-1}	II_{+-1}	II_{+-1}	M/s
Bjerkandera adusta (Willd.: Fr.) P. Karst.	.	.	I	II	II	I	S/w
Sphaerobolus stellatus Tode: Pers.	.	.	I_{1-2}	II_{2}	I_{2}	I_{2}	S/w
Phlebiopsis gigantea (Fr.: Fr.) Jülich.	.	.	II	V	II	.	S/w
Trametes versicolor (L.: Fr.) Pilát	.	.	II	II	III	.	S/w
Stereum hirsutum (Willd.: Fr.) S. F. Gray.	.	.	I	I	II	.	S/w
Daldinia concentrica (Bolt.: Fr.) Ces. et de Not.	.	.	I_{1-2}	I_{1-2}	I_{+-2}	.	S/w
Scleroderma citrinum Pers.	.	.	I_{+-2}	I_{+-2}	I_{+-1}	.	M/s
Auriscalpium vugare S. F. Gray	.	.	I_{+}	I_{+}	I_{+}	.	S/l
Trametes hirsuta (Wulf.: Fr.) Pilát	.	.	I	II	.	I	S/w
Macrolepiota procera (Scop.: Fr.) Sing.	.	.	II_{+-2}	III_{+-2}	.	.	S/s
Crucibulum laeve (Huds.) Kambly & Lee.	.	.	I_{1-2}	I_{2}	.	.	S/w
Nidularia pulvinata (Schwein.) Fr.	.	.	I_{2}	I_{1}	.	.	S/w
Stereum sanguinolentum (Alb. et Schw.: Fr.) Fr.	.	.	I	.	I	.	S/w
Psathyrella pennata (Fr.) Sing.	.	.	I_{1}	.	.	.	S/w
Clitocybe dealbata (Sow.: Fr.) Kumm.	.	.	I_{+-1}	.	.	.	S/l
Macrolepiota rhacodes (Vitt.) Sing.	.	.	I_{+-1}	.	.	.	S/s

Tab. 2 cont.

1	2	3	4	5	6	7	8
Botryobasidium candicans J. Erikss.	.	.	I	.	.	.	S/w
Coniophora arida (Fr.) P. Karst.	.	.	I	.	.	.	S/w
Hyphoderma puberum (Fr.) Wallr.	.	.	I	.	.	.	S/w
Inocybe lacera (Fr.) Kumm.	.	.	.	IV_{2-4}	IV_{1-4}	III_{+-2}	M/s
Suillus luteus (L.: Fr.) S. F. Gray	.	.	.	IV_{+-2}	II_{+-2}	II_{+-3}	M/s
Psilocybe montana (Pers.: Fr.) Kumm.	.	.	.	III_{+-3}	I_{1-2}	III_{1-3}	S/s
Leccinum scabrum (Bull.: Fr.) S. F. Gray	.	.	.	II_{+}	I_{+}	II_{+}	M/s
Hebeloma crustuliniforme (Bull.: Fr.) Quél.	.	.	.	II_{+-2}	I_{+-1}	I_{+-2}	M/s
Pycnoporus cinnabarinus (Jacq.: Fr.) P. Karst.	.	.	.	II	I	I	S/w
Collybia tuberosa (Bull.: Fr.) Kumm.	.	.	.	I_{1-2}	II_{1-2}	I_{2}	S/l
Hebeloma sacchariolens Quél.	.	.	.	I_{1}	I_{+-1}	I_{+-1}	M/s
Pluteus atromarginatus Kühn.	.	.	.	I_{+}	I_{+-1}	I_{+}	S/w
Gloeophyllum sepiarium (Wulf.: Fr.) P. Karst.	.	.	.	I	I	I	S/w
Phlebia radiata Fr.	.	.	.	I	I	I	S/w
Panaeolus sp.	.	.	.	III_{+-2}	I_{+-1}	.	S/s
Trichaptum abietinum (Pers. in J. F. Gmelin: Fr.) Ryv.	.	.	.	II	II	.	S/w
Phlebia tremellosa (Schrad.: Fr.) Nakas. et Burds.	.	.	.	II	I	.	S/w
Clavaria argillacea Pers.: Fr.	.	.	.	I_{2}	I_{2}	.	M/s
Coprinus micaceus (Bull.: Fr.) Fr.	.	.	.	I_{1-2}	I_{2}	.	S/s
Galerina vittiformis (Fr.) Sing.	.	.	.	I_{1-2}	I_{1}	.	S/s,m
Marasmius scorodonius (Fr.: Fr.) Fr.	.	.	.	I_{1}	I_{1-2}	.	S/l
Pleurotus dryinus (Pers.: Fr.) Kumm.	.	.	.	I_{1-2}	I_{1-2}	.	S/w
Mycena galopus var. nigra Fl. Dan.	.	.	.	I_{1}	I_{1}	.	S/l
Inocybe petiginosa (Fr. : Fr.) Gill.	.	.	.	I_{+-2}	I_{+-1}	.	M/s
Rhizopogon roseolus (Corda) Th. M. Fr.	.	.	.	I_{+-1}	I_{+-1}	.	M/s

Tab. 2 cont.

1	2	3	4	5	6	7	8
Paxillus panuoides (Fr.: Fr.) Fr.	.	.	.	II_{1-2}	.	II_{1-2}	S/w
Rhizopogon obtextus (Spreng.) Rauch.	.	.	.	II_{+-1}	.	I_{+}	M/s
Pleurotus ostreatus (Jacq.: Fr.) Kumm.	.	.	.	I_2	.	I_2	S/w
Gymnopilus sapineus (Fr.) Mre.	.	.	.	I_{1-2}	.	I_2	S/w
Flammulina velutipes (Curt.: Fr.) P. Karst.	.	.	.	I_2	.	I_1	S/w
Suillus bovinus (L.: Fr.) O. Kuntze	.	.	.	I_{+-1}	.	I_{1-2}	M/s
Amanita muscaria (L.: Fr.) Pers.	.	.	.	I_{+}	.	I_{+-1}	M/s
Amanita pantherina (DC.: Fr.) Krombh.	.	.	.	I_{+}	.	I_{+}	M/s
Hydnellum ferrugineum (Fr.: Fr.) P. Karst.	.	.	.	I	.	I	S/w
Mycena alcalina (Fr.: Fr.) Kumm.	.	.	.	II_{1-2}	.	.	S/w
Mycena aetites (Fr.) Quél.	.	.	.	II_{+-1}	.	.	S/l
Strobilurus stephanocystis (Hora) Sing.	.	.	.	II_{+-1}	.	.	S/l
Exidia plana (Wiggers) Donk	.	.	.	I_2	.	.	S/w
Panellus serotinus (Schrad.: Fr.) Kühn.	.	.	.	I_2	.	.	S/w
Ascocoryne sarcoides (Jacq.) Grov. et Wil.	.	.	.	I_{1-2}	.	.	S/w
Mycena ammoniaca (Fr.) Quél.	.	.	.	I_{1-2}	.	.	S/l
Dacryomyces minor Peck	.	.	.	I_1	.	.	S/w
Hymenoscyphus calyculus (Sow.: Fr.) Phill.	.	.	.	I_1	.	.	S/w
Polyporus arcularius (Batsch): Fr.	.	.	.	I_1	.	.	S/w
Baeospora myosura (Fr.: Fr.) Sing.	.	.	.	I_{+-1}	.	.	S/l
Strobilurus tenacellus (Pers.: Fr.) Sing.	.	.	.	I_{+-1}	.	.	S/l
Suillus variegatus (Swartz: Fr.) O. Kuntze	.	.	.	I_{+-1}	.	.	M/s
Xerocomus badius (Fr.) Kühn. ex Gilb.	.	.	.	I_{+-1}	.	.	M/s
Xerocomus subtomentosus (L.: Fr.) Quél.	.	.	.	I_{+-1}	.	.	M/s

Tab. 2 cont.

1	2	3	4	5	6	7	8
Clitocybe squamulosa (Pers.: Fr.) Kumm.	.	.	.	I_{+-1}	.	.	S/l
Gloeoporus dichrous (Fr.: Fr.) Bres.	.	.	.	I	.	.	S/w
Chondrostereum purpureum (Pers.: Fr.) Pouzar	.	.	.	I	.	.	S/w
Climacocystis borealis (Fr.) Kotl. et Pouzar	.	.	.	I	.	.	S/w
Faerberia carbonaria (Alb. et Schw.: Fr.) Pouzar	.	.	.	.	II_{+-2}	I_1	S/w
Polyporus ciliatus Fr.: Fr.	.	.	.	.	II_{+-1}	I_{+-1}	S/w
Hypholoma capnoides (Fr.: Fr.) Kumm.	.	.	.	.	I_{1-2}	I_{1-2}	S/w
Agrocybe semiorbicularis (Bull.: Fr.) Fay.	.	.	.	.	I_1	I_1	S/s
Panaeolus olivaceus Möller	.	.	.	.	I_1	I_1	S/s
Bovista pusilla (Batsch): Pers.	.	.	.	.	I_{+-1}	I_{+-1}	S/s
Pluteus petasatus (Fr.) Gill.	.	.	.	.	I_{+-1}	I_+	S/w
Fomitopsis pinicola (Sw.: Fr.) P. Karst.	.	.	.	.	I	I	S/w
Coprinus angulatus Peck	.	.	.	.	II_{+-1}	.	S/s
Lentinus tigrinus (Bull.: Fr.) Fr.	.	.	.	.	I_{1-2}	.	S/w
Collybia distorta (Fr.) Quél.	.	.	.	.	I_1	.	S/l
Coprinus sp.	.	.	.	.	I_1	.	S/s
Marasmius sp.	.	.	.	.	I_1	.	S/w
Nidularia deformis (Willd.: Pers.) Fr. et Nord.	.	.	.	.	I_1	.	S/w
Suillus grevillei (Klotzsch: Fr.) Sing.	.	.	.	.	I_1	.	M/s
Clitocybe brumalis (Fr.: Fr.) Quél.	.	.	.	.	I_{+-1}	.	S/l
Fomes fomentarius (L.: Fr.) Fr.	.	.	.	.	I	.	S/w
Mycena flavoalba (Fr.) Quél.	.	.	.	.	.	II_{+-2}	S/l
Gymnopilus penetrans (Fr.: Fr.) Murrill	.	.	.	.	.	I_{1-2}	S/w
Amanita rubescens (Pers.: Fr.) S. F. Gray	.	.	.	.	.	I_{+-1}	M/s
Clitopillus prunulus (Scop.: Fr.) Kumm.	.	.	.	.	.	I_1	S/l

Tab. 2 cont.

1	2	3	4	5	6	7	8
Cortinarius sp.	.	.	.	.	.	I_1	M/s
Cortinarius semisanguineus (Fr.) Gill.	.	.	.	.	.	I_1	M/s
Exidia saccharaina (Alb. et Schw.): Fr.	.	.	.	.	.	I_1	S/w
Mycena tenella (Fr.) Quél.	.	.	.	.	.	I_1	S/l
Omphalina ericetorum (Pers.: Fr.) M. Lge.	.	.	.	.	.	I_1	S/l
Pholiota spumosa (Fr.) Sing.	.	.	.	.	.	I_1	S/w
Pisolithus arhizus (Scop.: Pers.) Rausch.	.	.	.	.	.	I_1	M/s
Tubaria hiemalis Romagn.: Bon	.	.	.	.	.	I_1	S/s
Hebeloma mesophaeum (Pers.: Fr.) Quél.	.	.	.	.	.	I_{+-1}	M/s
Inocybe brunneoatra (Heim) P. D. Orton	.	.	.	.	.	I_{+-1}	M/s
Lactarius rufus (Scop.: Fr.) Fr.	.	.	.	.	.	I_{+-1}	M/s
Boletus edulis Bull.: Fr.	.	.	.	.	.	I_+	M/s
Entoloma sericeum (Bull.) Quél.	.	.	.	.	.	I_+	M/s
Leccinum versipelle (Fr. in Fr. et Hök) Snell	.	.	.	.	.	I_+	M/s
Pluteus cervinus (Schaeff.) Kumm.	.	.	.	.	.	I_+	S/w
Ramaria stricta (Pers.: Fr.) Quél.	.	.	.	.	.	I_+	S/w

Explanations: I – litter; m – mosses; M – mycorrhizal fungi; S – saprobic fungi; s – soil; w – wood

which occurs nearly in every vegetation patch examined, increases in time. *Deschampsia flexuosa* and *Agrostis capillaris*, as well as *Conyza canadensis*, *Populus tremula*, *Polytrichum juniperinum* and *Vaccinium vitis-idaea* play an increasing role in the group of associated species owing to their growing occurrence. P a r u s e l (1998), who examines vegetation succession in a burnt forest in Rudzkie Forests, also emphasises great abundance and constancy of the species such as *Calamagrostis epigejos*, *Chamaenerion angustifolium*, *Agrostis capillaris*, *Deschampsia flexuosa*, *Polytrichum juniperinum* and *Ceratodon purpureus*. However, as the habitat of the mixed forest in Rudzkie Forests is moister, representatives of the *Sedo-Scleranthetea* class were less numerous than in Notecka Forest, while representatives of the *Molinio-Arrhenatheretea* – more numerous.

Over this short period of study, forest species, including species typical of the sub-continental fresh forest *Peucedano-Pinetum*, which had occurred here before the fire (*Peucedanum oreoselinum, Scorzonera humilis, Polygonatum odoratum*) appeared.

Trees of young age increased their coverage every year thus bringing about shadowing of the substrate and abating the drying effect of winds. It had an advantageous influence on environment changes, moisture conditions in particular. A cutting of densely planted pines to increase the distance between them to ca. 50 cm and a clearance of deciduous trees were carried out in the summer of 1997. Only birches in scattered "nests" and in rows situated every ten or twenty meters along fire lanes were left. Due to a long-lasting process of repeated forest planting, pines in the areas examined were between 2 and 6 years old in 1998. Apart from the species of the deciduous trees planted, individual groups were observed: *Betula pubescens, Populus tremula, Salix caprea, Sorbus aucuparia* and *Padus serotina.*

MACROMYCETES DIVERSITY

Over the first six years following the fire, 134 species of fungi and 3 species of myxomycetes were collected (Table 2). The number of species increased initially to reach as many as 87 species in the fourth year after the fire, and decreased by less than 20% in the following years. While more species of plants

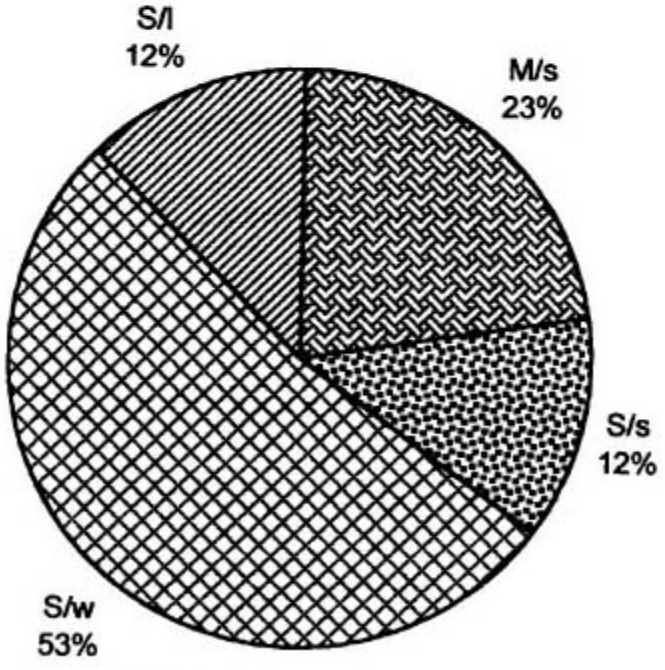

Fig. 2. Participation of bio-ecological groups of macromycetes in pine plantings in the burnt forest in Notecka Forest. M/s – mycorrhizal fungi, S/s – humicolous saprotrophes, S/w – lignicolous saprotrophes, S/l – litter-inhibiting saprotrophes

than of fungi occurred in the first two years after the fire, the number of species of both was the same in the third year. There were, on the average, twice as many fungi in the fourth year.

Saprobic fungi that constitute nearly 77% of the macromycetes examined prevail, and lignicolous fungi (Fig. 2) occur most often among them; other fungi are mycorrhizal species.

The participation of individual bio-ecological groups varied in the subsequent years following the fire (Fig. 3). Lignicolous fungi that constituted 92% of macromycetes prevailed in the first year. Their number gradually decreased

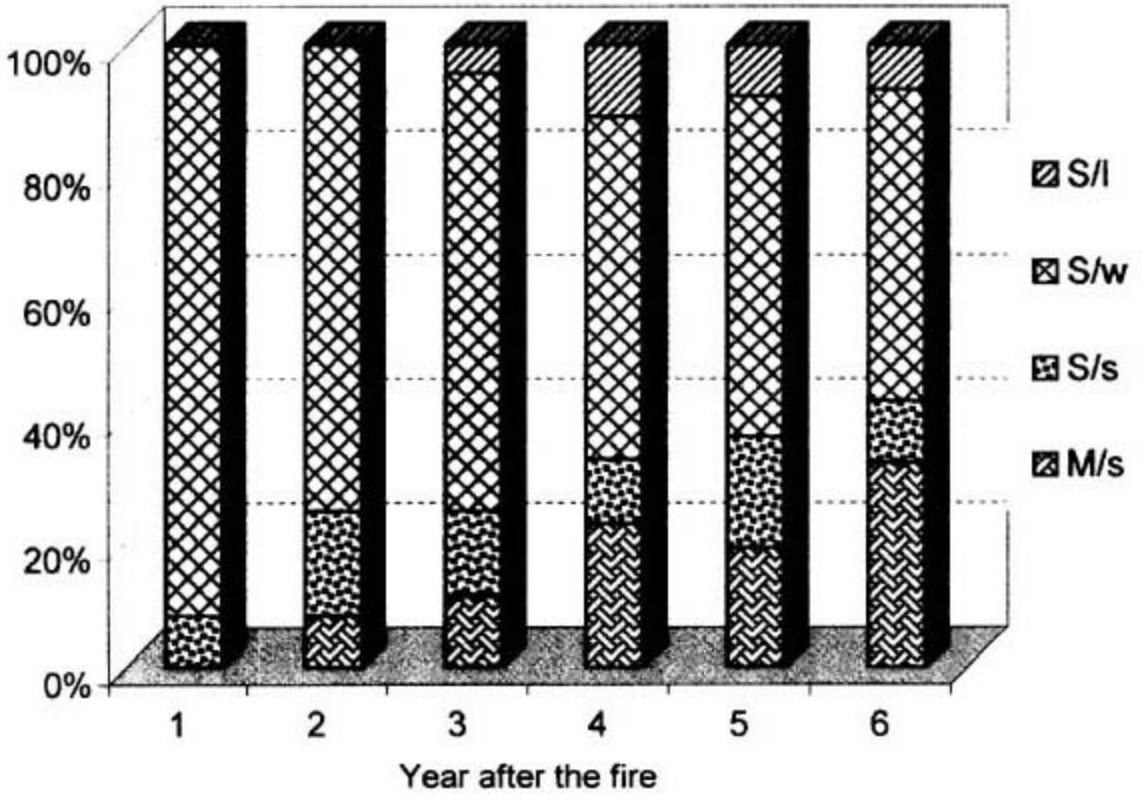

Fig. 3. Participation of bio-ecological groups of macromycetes in pine plantings in the burnt forest in Notecka Forest in the years after the fire. For explanations – see Fig. 2

over the next years, reached 50% in the sixth year after the fire and approximates the participation of this group in macromycetes examined throughout the study. The participation of litter-inhabiting fungi ranged between 8 and 18 in individual years, and reached the greatest number in the fifth year of study. Due to the absence of leaf litter in the initial period of the study, humicolous saprobes appeared only in the third year after the fire, and their participation ranged between 5 and 12%. Mycorrhizal fungi, however, formed first fruit-bodies in the second year after the fire, constituting 8% of all fungi collected that year. Apart from the fifth year, when their growth halted

slightly, their participation gradually increased every year and reached its maximum (33%) in the final year of the study.

Eleven species of lignicolous fungi and only one species of terrestrial fungus were collected in the first year of study (Table 2, Fig. 4). The species was *Rhizina undulata*, which fruited extensively in the whole area of the burnt forest, and reached the 5th degree of quantity in individual areas. This typically pyrophylous species occurred to a smaller extent and less numerously in the subsequent years. Dying birches that had remained in the burnt forest were inhabited by *Piptoporus betulinus*. Other lignicolous fungi were associated with pine wood. *Pholiota carbonaria, Tephrocybe antracophila, T. atrata* and *Plicaria leiocarpa* grew on charred or burnt wood. These species occurred also in the next three or four years. It is worth noting that the only species of saprobic fungi that occurred throughout the six years of study were *Armillaria mellea, Hypholoma fasciculare* and *Fuligo septica*.

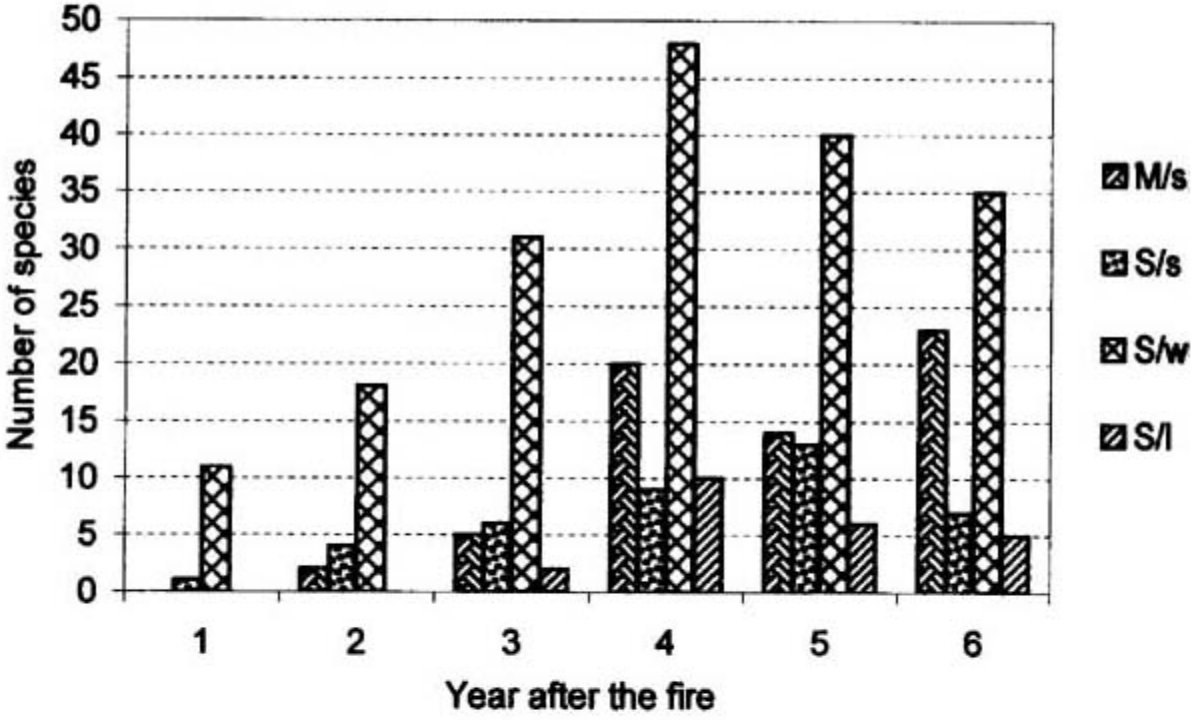

Fig. 4. Number of species of bio-ecological groups of macromycetes in pine plantings in a burnt forest in Notecka Forest in the years after the fire. For explanations – see Fig. 2

Twenty-four species of macromycetes occurred in the second year following the fire. First 16 species appeared, including two mycorrhizal species. These were *Thelephora terrestris* and *Laccaria proxima*, which developed few fruit-bodies. In the group of pyrophytes, the species observed the previous year occurred, with the exception of *Tephrocybe atrata*, which did not fruit, while *Myxomphalia maura* and *Tephrocybe ambusta* appeared. *Pholiota carbonaria*

developed highly extensively and formed over 500 fruit-bodies in several areas. Half of the fungi that were observed for the first time in plantings was also noticed in all subsequent years. These were lignicolous fungi *Calocera furcata, Dacryomyces stillatus, Gymnopilus hybridus, Pholiota astragalina, Lycogala epidendrum*, as well as mycorrhizal fungi *Laccaria proxima* and *Thelephora terrestris* and humicolous fungus *Coltricia perennis*. Single fruit-bodies of *Rickenella fibula* appeared in turfs of *Polytrichum piliferum*.

The number of fungal species in 1995, that is in the third year of observations, almost doubled in comparison with the previous year; 20 species of fungi appeared for the first time, only five of them, however, occurred in all subsequent years of study. Forty-four species were collected that year altogether, including 5 mycorrhizal species: *Laccaria proxima, L. laccata, Thelephora terrestris, Paxillus involutus* and *Scleroderma citrinum*. Apart from *Paxillus involutus* that developed only few fruit-bodies in the whole area of study other species of this group developed more than twenty fruit-bodies in individual plots. W a t l i n g (1988) considers *Laccaria laccata* to be a pioneer species in burnt forests. Litter-inhabiting fungi, *Auriscalpium vulgare* and *Clitocybe dealbata*, were recorded for the first time that year. *Phoilota carbonaria* that developed on the remnants of charred wood, often covered with sand, fruited most abundantly that year, similarly to the previous year. It was the year when this species fruited most extensively, reaching the greatest intensity in September. Other carbophilous species produced between ten and twenty fruit-bodies in the study area. *Daldinia concentrica*, a species that develops on charred birch logs, is a new species in this group. It was the final year of occurrence of *Rhizina undulata*, a species common in burnt forests, one of the most dangerous parasites of young coniferous trees. Thus this fungus did not threaten pine-tree seedlings in plantings in Notecka Forest. It should be noticed that humicolous fungi such as *Macrolepiota procera, M. rhacodes* and *Hygrophoropsis aurantica* occurred for the first time during the study.

The richest assemble of macromycetes with 87 species, including as many as 50 species that appeared for the first time, was recorded in the fourth year following the fire (1996). Mycorrhizal fungi the number of which doubled in comparison with the previous year were the most important in this group. Species such as *Suillus luteus, Leccinum scabrum, Inocybe lacera, Hebeloma crustuliniforme* and *H. saccharіolens* fruited in the following years as well. Nineteen species, however, including *Xercomous badius, X. subtomentosus* and *Suillus variegatus*, occurred only that year. *Hypholoma fasciculare, Thelephora terrestris, Laccaria laccata* and *L. proxima* were the species that fruited most abundantly in the whole area of study (5^{th} or 4^{th} degree of quantity). *Gymnopilus hybridus* and *Pholiota carbonaria*, on the other hand, produced a large number of fruit-bodies only in some observation plots.

The overall number of species decreased slightly in the fifth year of study (1997); 73 species were observed, 17 of which occurred for the first time. *Faerberia carbonaria* and *Coprinus angulatus* are two pyrophilous species that

had not been recorded earlier. On the other hand, the majority of the species in this group that had occurred in the previous years ceased to fruit. Quantitatively, *Thelephora terrestris* and *Hypholoma fasciculare* prevailed. *Coltricia perennis* was the species that produced single fruit-bodies. Fruit-bodies of *Suillus grevillei* were found under larches.

Seventy species of fungi were collected in the dry final, sixth year of study. Twenty of them, including mycorrhizal species such as *Amanita rubescens, Boletus edulis, Leccinum versipelle, Lactarius rufus* and *Pisolithus arhizus*, had not occurred in the pine-tree plantings examined until then. The greatest number of mycorrhizal fungi was collected that year, and their participation in the total number of macromycetes was also the greatest (Figs 3, 4). It should be emphasised, however, that apart from *Inocybe lacera, Laccaria proxima, L. laccata, Thelephora terrestris*, and *Suillus luteus* that year, other species of mycorrhizal fungi developed few fruit-bodies.

DISCUSSION

D y l ą g and G u m i ń s k a (1997) examined the macrofungi of a burnt bog forest *Vaccinio uliginosi-Pinetum* for a period of two years. Out of the 54 species of fungi and myxomycetes found in the vicinity of Chrzanów, 39 species were also found in the plantings in the burnt forest in Notecka Forest. Similarities between the two areas were striking already in the first two years of observations: as many as 20 species out of 28 species of macromycetes collected over this period of time were the same for both areas. Only 15 species of the fungi that occurred in the burnt forest near Chrzanów were not found in the pine-tree plantings. In the group of carbophylous fungi, D y l ą g and G u m i ń s k a did not find *Tephrocybe atrata* and *Plicaria leiocarpa*, which were recorded in Notecka Forest. Fruiting of some species of pyrophylous fungi in Notecka Forest, however, started only in the following years. It should be stressed that one of the most common pyrophylous fungi, *Geopyxis carbonaria* (M o s e r 1949; G i n k o 1984; T u r n a u 1984; W a t l i n g 1988, D y l ą g and G u m i ń s k a 1997), was not recorded despite a deliberate search for it.

In the group of macrofungi of the plantings examined in which grassland with *Corynephorus canescens* develops species of fungi typical of this vegetation community occur (K r e i s e l 1970; A r n o l d s 1981; K r i e g l s t e i n e r 1999). Species characteristic of the *Spergulo-Corynephoretum* and higher syntaxa among the fungi found are: *Psilocybe montana, Bovista pusilla, Clavaria argillacea, Rhizopogon obtexus, Hygrophoropsis aurantiaca*, and the associated species that occur frequently are: *Agrocybe semiorbicularis, Galerina vittiformis, Laccaria laccata* and *Marasmius oreades*. Forest species, such as *Xerocomus badius, Coltricia perennis, Inocybe lacera, Amanita muscaria, Cortinarius semisanguineus, Lactarius rufus*, also appear in the course of time.

Rare and threatened species found shelter in pine-tree plantings in the burnt forest in Notecka Forest. The following fungi from a group of 100 higher species charted in Europe (Skirgiełło 1962) occur: *Pycnoporus cinnabarinus, Auriscalpium vulgare, Armillaria mellea, Pisolithus arhizus, Fomes fomentarius, Piptoporus betulinus, Rhizina undulata, Schizophyllum commune, Clitopilus prunulus. Pisolithus arhizus* is a very rare species in Poland and in Germany in this group (Calonge and Ławrynowicz 1982 (1986); Rudnicka-Jezierska 1991; Kreisel 1987; Krieglsteiner 1991). It should be noted that the area of Notecka Forest is "terra incognita" on maps of distribution of the above species in Poland. Three species found in the burnt forest: *Schizophyllum commune, Xerocomus badius and Amanita muscaria* are on a list of species to be monitored in our country (Ławrynowicz 2000). The following species that are listed in the Red List in Poland (Wojewoda and Ławrynowicz) were recorded in the study area: V category – *Boletus edulis*, R category – *Botryobasidium candicans, Pycnoporus cinnabarinus, Faerberia carbonaria, Pleurotus dryinus, Nidularia deformis, Pisolithus arhizus* and in I category – *Calocera furcata, Lentinus trigrinus, Macrolepiota procera, M. rhacodes, Myxomphalia maura, Omphalina ericetorum, Pluteus petasatus, Psilocybe montana.* Three species from the Red List of threatened fungi in Mecklenburg (Kreisel 1992), the area adjacent to the western border of Poland, were found in the examined area of Notecka Forest: *Clavaria argillacea, Rhizopogon obtexus* and *Leccinum versipelle.*

Pine plantings in burnt pine forests provide excellent material for studies on fungal succession. Such long-term studies have been planned for a number of years in the future and will be accompanied by concomitant observations in a subcontinental fresh pine forest *Peucedano-Pinetum.*

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Różnorodność macromycetes nasadzeń sosnowych na po-pożarowych siedliskach leśnych w Puszczy Noteckiej

Streszczenie

Praca zawiera wyniki badań nad sukcesją grzybów i roślin w nasadzeniach sosnowych na pożarzysku w Nadleśnictwie Potrzebowice w Puszczy Noteckiej. Pożar miał miejsce 10 czerwca 1992 roku i strawił prawie 5 tysięcy ha borów sosnowych. Po wycince opalonych drzew przeprowadzono nasadzenia sosny.

Badania prowadzone są od 1993 roku, a w pracy prezentowane są wyniki pierwszego etapu obejmującego okres sześciu lat po pożarze. Obserwacje dokonywane są na 25 powierzchniach stałych o wielkości 400 m^2, średnio 8 razy w ciągu roku.

W nasadzeniach sosnowych, z biegiem lat, wykształciła się murawa szczotlichowa *Spergulo morisonii-Corynephoretum canescentis* ze znacznym udziałem gatunków charakterystycznych dla zrębów i pogorzelisk z klasy *Epilobietea angustifolii*. Współwystępują z nimi gatunki z klasy *Nardo-Callunetea*, zaczynają pojawiać się gatunki borowe.

W ciągu sześciu lat badań zanotowano 134 gatunki grzybów i 3 gatunki śluzowców. W pierwszym roku po pożarze wystąpiło tylko 12 gatunków. W kolejnych latach liczba owocujących gatunków zwiększała się osiągając maksimum wynoszące 87 gatunków w czwartym

roku, a w następnych latach nieznacznie się obniżyła. W mikoflorze nasadzeń dominują saprotrofy, a wśród nich grzyby nadrzewne; grzyby mikoryzowe stanowią 23%. Udział grup bioekologicznych macromycetes w kolejnych latach ulegał zmianom. W pierwszym roku po pożarze dominowały grzyby nadrzewne stanowiące aż 92% tegorocznej mikoflory. W następnych latach ich udział zmniejszał się, osiągając 50% w szóstym roku badań. Grzyby mikoryzowe pojawiły się dopiero w drugim roku po pożarze stanowiąc 8% gatunków zebranych w tym roku. W kolejnych latach ich udział zwiększał się osiągając 33% w ostatnim roku badań. Udział saprotrofów naściółkowych i napróchnicznych w poszczególnych latach wahał się w od 5 do 18% mikoflory stwierdzonej w danym roku.

Grzyby pyrofilne reprezentowane były przez 10 gatunków, spośród których najdłużej i najobficiej owocowały: *Rhizina undulata* i *Pholiota carbonaria* oraz *Tephrocybe antracophila* i *T. atrata*. W mikoflorze nasadzeń obserwowano grupę gatunków grzybów związanych z murawami napiaskowymi, zaczęły pojawiać się również gatunki borowe.

Na badanym terenie w Puszczy Noteckiej znalazło ostoję wiele gatunków grzybów rzadkich i zagrożonych. Stwierdzono występowanie 15 gatunków z Czerwonej Listy, 3 gatunki monitorowane w Polsce i 9 gatunków kartowanych w Europie. Osiągnięte wyniki i unikatowy warsztat, jakim są nasadzenia sosnowe na pożarzysku boru świeżego, zachęcają do kontynuowania wieloletnich badań.