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Changes in macrofungal flora of Cracow (S. Poland)

Władysław WOJEWODA

1. INTRODUCTION

In recent years mycologists from several European countries inform that macrofungi flora is becoming impoverished: the production of carpophores has decreased and particular species have disappeared (ARNOLDS 1988). The problem of disappearance of sites with macromycetes in Poland has been signalled too (e.g. WOJEWODA 1976). In this paper the changes in the macrofungi flora of Cracow city in the period 1883-1990 are analysed.

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2. STUDY AREA AND SUBJECT

Cracow is the third greatest city of Poland and obtained city rights in 1257. It comprises an area of 327 km^2 and has 800'000 inhabitants. It is situated in the Vistula Valley at an altitude of about 200-400 m a.s.l., on the border of four geographic regions: Cracow Upland, Miechow Upland, Sandomierz Basin and Carpathian Foothills.
Mean air temperatures from 1831-1960: January -3.1°C, July 18.5°C; absolute minimum air temperatures from 1864-1949: February -33.1°C, absolute maximum in August: 37.4°C, mean sum of precipitations from 1850-1949:

665 mm, maximum sum of annual precipitations: 900 mm, minimum: 430 mm (HESS 1974).

The vegetation of Cracow varies markedly. About 70 plant communities have been distinguished in the area. Most close to natural communities are only forests and a part of xerothermic grasslands. Forest relicts occupy only 1000 ha, xerothermic grasslands not a large area, parks ca. 300 ha, allotment gardens ca. 615 ha. Semi-natural properties are retained by meadows which are fairly frequent in the city, though they were drained, built over or planted with trees. Only ca. 15% of the territory under city administrations is covered by meadows, pastures, xerothermic grasslands, and forests (DUBIEL 1988, 1991, KORNAS and MEDWECKA-KORNAS 1974).

During the last 45 years the city has changed a lot. The number of inhabitants tripled and the industrialization developed. The biggest Polish ironworks was built, and, apart from that, chemical and cement industry expanded. Adjacent to the city limits, in the town of Skawina, a huge electric power station was built and the aluminium works emit (among other pollutants) fluor. Cracow is polluted by dusts and fumes from the biggest Polish industrial centre, the Upper Silesian Industrial Centre, located about 80 km W of the city. Eastern winds, on the other hand, carry fumes and dusts from the chemical industry in Tarnow located 75 km E from Cracow.

The total annual emission in the Cracow urban-industrial agglomeration amounts to 170'000 tons of SO_2 and 150'000 tons of dust containing large quantities of toxic heavy metals (e.g. 170 tons Pb, 7 tons of Cd, 18'000 tons of Fe). In the Niepolomice Forest (10-35 km E of the centre of Cracow, 11'000 ha), the average annual concentration of SO_2 in the air is 25 μgm^{-3}. The average annual concentration of dust is 46.2 μgm^{-3}. Rain is highly polluted in this forest (GRODZINSKA 1982).

Cracow is subjected to heavy pressure from pollution, coming mainly from local sources, but also transported from distant ones. On average annual deposition in Cracow is 200 tons/km^2. The dust contains considerable amounts of heavy metals (GRODZINSKA et al. 1987).

Increase in the number of inhabitants, development of industry, new housing estates, roads and railways have induced changes in the vegetation and the flora of fungi.

The subject of studies were macrofungi (Asco- and Basidiomycetes) whose fruit bodies were not smaller than 0.5 cm in diameter.

Nomenclature of fungus taxa is mostly according to KREISEL (1987). The studies on fungi in Cracow were started by a renowned Polish mycologist,

Marian Raciborski in 1883 (WROBLEWSKI 1926). The author of this paper carried out his studies from 1955-1990 and collected materials from all accessible places of the city, in each season, winter included.

3. FREQUENCY OF MACROFUNGI

Till 1955 only some species had been known from Cracow. From 1883-1990 about 700 species including 40 Ascomycetes and about 660 Basidiomycetes have been recorded.

Based on the number of localities in the study area frequency of macrofungi in Cracow was estimated. The distance of 1 km between the nearest localities was assumed. The following frequency scale was applied: >20 localities = very common species, 11-20 = common, 4-10 = rare, 1-3 = very rare (Fig. 1).

Very common fungi. Only 13 very common fungi have been found in the city, e.g. *Bjerkandera adusta*, *Cerocorticium confluens*, *Coprinus disseminatus*, *Ganoderma lipsiense*, *Hirneola auricula-judae*, *Rogersella sambuci*, *Schizophyllum commune*, *Schizopora paradoxa* s.l., *Stereum hirsutum* and *Trametes versicolor*. They constitute only 2% of the flora.

Common fungi. Common fungi are represented by 64 species (9%) e.g., *Agrocybe praecox*, *Coprinus comatus*, *Cylindrobasidium laeve*, *Flammulina velutipes*, *Hyphoderma setigerum*, *Hypholoma fasciculare*, *Laetiporus sulphureus*, *Meripilus giganteus*, *Mycena galericulata*, *Peniophora quercina*, *Phallus impudicus*, *Piptoporus betulinus*, *Pluteus atricapillus* and *Trametes hirsuta*.

Rare fungi. About 150 rare fungi were found (21% of the flora) e.g., *Achroomyces peniophorae*, *Cyathus olla*, *Daedalea quercina*, *Hymenochaete rubiginosa*, *Lactarius glyciosmus*, *Macrolepiota rachodes*, *Morchella gigas* (= *Mitrophora semilibera*), *Mycena epipterygia*, *Mycena inclinata*, *Ossicaulis lignatilis* (= *Clitocybe lignatilis*), *Polyporus badius*, *Scleroderma bovista*, *Scopuloides hydnoides*, *Sebacina incrustans*, *Steccherinum ochraceum*, *Vesiculomyces citrinus* and *Volvariella speciosa*.

Very rare fungi. More than 400 very rare fungi were found (about 58% of the flora), e.g. *Achroomyces disciformis, Bovista graveolens, Bovista nigrescens, Bulbillomyces farinosus, Ceratobasidium cornigerum, Ceriporiopsis mucida, Cerocorticium molare, Clavulina rugosa, Fistulina hepatica, Geastrum fimbriatum, Geastrum rufescens, Hypochnicium polonense, Inocybe commutabilis, Irpex lacteus, Lentinellus cochleatus, Leucogyrophana pinastri, Macrotyphula fistulosa, Marasmius alliaceus, Morchella elata, Morchel-*

la esculenta, Nidularia deformis, Pluteus leoninus, Pseudomerulius aureus, Russula rosea, Steccherinum fimbratum, Stropharia albocrenulata, Tulasnella inclusa, Tulasnella violea, Tylospora asterophora, Uthatobasidium ochraceum and *Volvariella taylori.*

It should be emphasized, that numerous fungi which are rare or rather rare in Cracow, are common or even very common in other regions of Poland, e.g. *Amanita citrina, Amanita rubescens, Amanita vaginata, Calocera viscosa, Calocybe gambosa, Clitocybe sinopica, Clitopilus prunulus, Crepidotus mollis, Fomitopsis pinicola, Helvella bulbosa* (= *Macroscyphus macropus*), *Hygrophorus hypothejus, Lactarius volemus, Pseudohydnum gelatinosum, Skeletocutis amorpha, Trichaptum holli* (= *Trichaptum fuscoviolaceum*) and *Tricholoma terreum.*

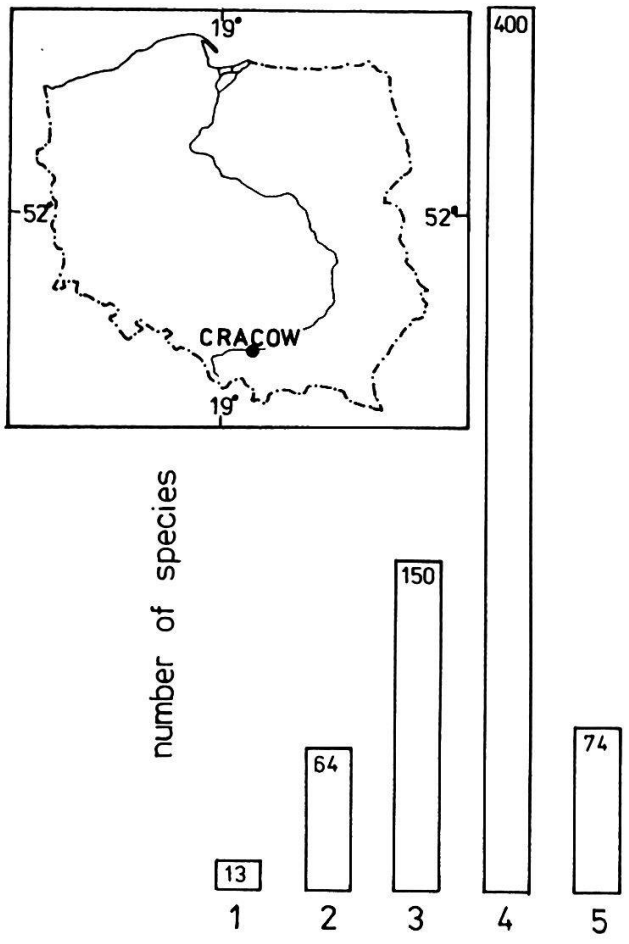

Fig. 1. Frequency of macrofungi in Cracow city.
1 = very common fungi, 2 = common, 3 = rare, 4 = very rare, 5 = probably extinct in Cracow

4. CHANGES IN MACROFUNGAL FLORA

4.1. DECREASING FREQUENCY OF FUNGI

Macrofungi are disappearing in Cracow during the last 30-40 years.
As many as 74 species may be labelled as **probably extinct** (about 10% of the flora of macrofungi). For more than 15-20 years no specimens of *Clavariadelphus pistillaris, Clitocybe clavipes, Coltricia perennis, Creolophus cirratus, Exidia saccharina, E. thuretiana, Faerberia carbonaria, Geastrum quadrifidum, Geastrum triplex, Hypholoma capnoides, Mycena pelianthina, Nyctalis asterophora, Panellus mitis, Paxillus atrotomentosus, Polyporus melanopus, Polyporus varius, Ramaria botrytis, Sclerotinia tuberosa, Thelephora caryophyllea, Trametes cervina and Tremella foliacea* have been found. It may be conjectured that many of the currently rare species may soon be included in the list of extinct species of Cracow.
The process of **extinction of fungi** from the genera *Amanita, Boletus, Camarophyllus, Cantharellus, Chroogomphus, Cortinarius, Craterellus, Entoloma, Hebeloma, Hydnum, Hygrocybe, Hygrophorus, Inocybe, Lactarius, Leccinum, Leucocortinarius, Pseudocraterellus, Russula, Suillus, Thelephora, Tricholoma* and *Xerocomus* have been observed (Table 1).
It is partially the result of the disappearance of trees, especially conifers, with which these fungi live in symbiosis. This situation observed in other regions of Poland and in the neighbouring countries. In the period 1958-1961 NESPIAK (1971) recorded 40 species of mycorrhizal fungi from the highest localities in the Polish Sudetes. FELLNER (1986) found only 10 species of mycorrhizal fungi in the period 1980-1983 in the neighbouring regions of Czech Sudetes. The main reason of disappearance of mycorrhizal fungi is acid rain in the strongly industrialized areas (FELLNER 1988). The dramatic change was apparently shown by ectomycorrhizal fungi, e.g. in the Netherlands (ARNOLDS 1988).
Apart from the **fungi connected with coniferous trees** through mycorrhiza, also saprobic and parasitic fungi on conifers are disappearing. *Abies alba* has been absent in Cracow for many years now, *Picea abies* is very rare, and *Pinus sylvestris* is endangered. Rare or very rare in Cracow are e.g. *Antrodia serialis, Calocera viscosa, Dacryomyces estonicus, Dacryomyces ovisporus, Gloeophyllum odoratum, Lactarius rufus, Meruliopsis taxicola, Onnia triqueter, Phaeolus schwenizii, Phellinus pini, Russula ochroleuca, Scleroderma citrinum, Setulipes androsaceus* (= *Marasmius androsaceus*), *Strobilurus esculentus, Thelephora terrestris* and *Tremella encephala.*

In Poland mushrooms are **collected for food** in large quantities, which accelarates their extinction (WOJEWODA and LAWRYNOWICZ 1986). *Xerocomus badius*, the most common mushroom occurring in Poland was recorded from Cracow within the period 1955-1990 only from one place in 1987. *Cantharellus cibarius* is very rare, *Boletus reticulatus, Lactarius semisanguifluus, Leccinum griseum, Leccinum rufum, Leccinum versipelle, Suillus bovinus, Suillus granulatus* and *Suillus luteus* are almost extinct, *Macrolepiota procera* and *Xerocomus chrysenteron* are not so rare, *Marasmius oreades* and *Armillaria mellea* s.l. are the only common species.

Fungi of natural forests. In the last years extinction of macrofungi has been observed in natural, old, humid and shady deciduous forests, peat-bogs and humid meadows and xerothermic grasslands.

The riverside forests are almost absent from Cracow, there are only scarce remnants on the riverbanks of the Vistula river and its tributaries. *Auriculariopsis ampla, Coriolopsis trogii, Cytidia salicina, Exidia recisa, Lentinus tigrinus, Oxyporus corticola*, and *Pluteus aurantiorugosus* for example are very rare in fragments of these forests.

Beech and oakhorn-beam forests (*Tilio-Carpinetum*) are relatively well-preserved. In this association, but mostly in the Panienskie Skaly reserve in the Wolski Forest, rare fungi, e.g. *Boletus pulverulentus, Datronia mollis, Hericium clathroides, Ischnoderma resinosum, Laxitextum bicolor, Lopharia spadicea, Mutinus caninus, Phylloporus pelletieri, Protodontia subgelatinosa, Stereum subtomentosum and Xerula pudens*, may still be found.

Fungi of peat-bogs and humid meadows. In 1968 and 1964 *Lycoperdon caudatum* and *Tephrocybe palustris* were collected the last time from this area.

Fungi of xerothermic grasslands. Fungi connected with xerothermic grasslands are becoming rarer and rarer, e.g. *Bovista tomentosa, Crinipellis stipitaria* and *Geastrum minimum. Tulostoma brumale* was collected in Cracow for the last time in 1910 (WODZICZKO 1911).

Coprobious fungi. In the last years the number of cattle has decreased in Cracow, horses are very rare, the raising of goats has stopped, only poultry is kept. In the past coprobious fungi were very frequent in the settlements in the suburbs (hundreds or even thousands of specimens), e.g. *Panaeolus sphinctrinus*, and *Stropharia semiglobata.* At present these fungi are rarer than before.

Nanism of fructifications. Imposing fructifications of fungi are very rare. Fungi, which in favourable conditions may assume considerable proportions,

develop small or average fructifications, e.g. *Fomitopsis pinicola* or *Fomes fomentarius*. Big fructifications are exceptional, e.g. *Ganoderma lipsiense* and *Polyporus squamosus*.

Replacement refugia of fungi. Some rare and more sensitive fungi have disappeared in natural habitats and found replacement habitats in parks, squares, avenues with old trees, old cemeteries and botanical gardens (e.g. *Abortiporus biennis, Climacodon septentrionalis, Coltricia perennis, Coriolopsis gallica, Neolentinus schaefferii, Phaeolus schweinizii, Polyporus tuberaster* and *Pycnoporus cinnabarinus*). *Aurantiporus fissilis* and *Sarcodontia crocea* were found in gardens on *Malus domestica, Cyathus stercoreus* and *Langermannia gigantea* in refuse dumps and allotment gardens and *Auricularia mesenterica* on wooden flowerpots in greenhouses in the botanical garden.

4.2. NEW AND EXPANSIVE FUNGI

Synanthropic fungi. SKIRGIELLO (1990) wrote on synanthropic fungi in Poland. They occur in Poland in secondary places and are introduced by man from other countries or other regions of Poland. Tropical fungi i.e. *Mycena floccifera* (= *Mycena osmundicola*) and *Leucoprinus birnbaumii* are found in greenhouses of the botanical garden, in flowerpots with exotic plants, *Leucoprinus birnbaumii* was even observed in flowerpots with *Ficus* in a Warsaw supermarket.

On planks in garden frames and on scaffold beams fungi introduced from the Carpathians occur (e.g. *Amylostereum chailletii* and *Hericium flagellum*, connected with *Abies alba*). *Neolentinus lepideus* is only common on wooden railway and tram sleepers, *Asterostroma ochroleucum* and *Cyathus olla* were noted from wooden flowerpots in flats and on balconies.

Expansive fungi. In recent years some fungi, both European and exotic, spread in Europe and in Poland, e.g. *Clathrus archeri* (STENGL-REJTHAR and WOJEWODA 1985). In Cracow *Phallus impudicus* is frequently found in parks and forest. *Mutinus ravenelii* is introduced from warmer regions (GUMINSKA 1985, SOKOL and SZCZEPKA 1987). *Schizopora carneolutea* has strongly increased in Europe (KEIZER 1990), in Poland it was found in Cracow in the Wolski Forest (*Tilio-Carpinetum*), in the Bialowieza National Park and in the Raciborz Basin.

5. COMPARISON OF MACROFUNGI OF CRACOW AND OTHER TOWNS IN POLAND AND OTHER COUNTRIES

Macrofungi of Cracow and other Polish towns

No complete list of macrofungi in Polish cities has been published until now. Macrofungi were studied in Warsaw by CHELCHOWSKI (1888, 1898) and by SKIRGIELLO and DOMANSKI (1981) and in Wroclaw by SCHROETER (1885-1908). In Lodz (214 km^2, ca. 845'000 inhabitants) LAWRYNOWICZ (1982) recorded 162 species from the city centre and 403 from its suburbs. In Szczecin (300

Table 1. Number of species of mycorrhizal genera in some European botanical gardens.

Genus	Gothenburg (Sweden)	Greifswald (Germany)	Cracow (Poland)
Amanita	9	1	-
Boletinus	1	-	-
Boletus	6	1	-
Camarophyllus	3	-	-
Cantharellus	3	-	-
Chroogomphus	-	1	-
Cortinarius	17	5	4
Craterellus	1	-	-
Elaphomyces	1	-	-
Entoloma	13	5	2
Gomphidius	3	-	-
Hebeloma	3	2	2
Hygrocybe	7	-	-
Hygrophorus	4	1	-
Hydnellum	3	-	-
Hydnum	2	-	-
Inocybe	4	5	4
Laccaria	4	2	2
Lactarius	28	9	5
Leccinum	2	1	-
Paxillus	1	1	1
Russula	32	12	2
Sarcodon	1	-	-
Scleroderma	3	2	1
Suillus	4	2	2
Thelephora	4	-	-
Tricholoma	20	4	-
Tylopilus	1	-	-
Xerocomus	31	1	1
Total	183	55	26

km^2, ca. 400'000 inhabitants) FRIEDRICH (1989) recorded 200 species in the period 1973-1985. In Kielce (110 km^2, 208'000 inhabitants) LUSZCZYNSKI (personal comm.) recorded about 400 species in the period 1986-1990. The data of the above-mentioned cities are scarcely comparable as the authors worked at different periods and, undoubtedly focused unequally on particular systematic groups of fungi.

Polyporoid fungi of Cracow and Helsinki

The polyporoid fungi of Helsinki (185 km^2, ca. 500'000 inhabitants) were studied by ERKKILA and NIEMELA (1986; 120 records). In Cracow only about 90 species of polyporoid fungi have been found. There are not many of fungi connected with coniferous trees. Some of these fungi rather common in Helsinki (e.g. *Spongiporus guttulatus* or terrestrial species from the genus *Scutiger*) are absent in Cracow. The flora of polyporoid fungi of Cracow is poorer than that of Helsinki as to the the number of species and the frequency.

Macrofungi from the Botanical Garden in Cracow

About 200 species have been found in the Botanical Garden of the Jagellonian University in Cracow and in the Botanical Garden of the University Greifswald (NE Germany) (KREISEL 1967). Both these gardens are typical and little (in Cracow ca. 10 ha, in Greifswald 5.5 ha). From the Botanical Garden in Gothenburg (SW Sweden) 700 species of macrofungi were recorded (KARLVALL 1963), almost as many as were collected from the whole area of Cracow, but this garden has a dimension of 175 ha (15 ha typical part, 35 ha untouched nature park and 125 ha natural or semi-natural forest vegetation). The macrofungi flora is much richer in Gothenburg Botanical Garden than in Greifswald and in Cracow (only 11 genera and 26 species) (Table 1).

Macrofungi of Cracow and Berlin (West)

1322 species of macrofungi (255 Ascomycetes and 1067 Basidiomycetes) have been found in Berlin (West), (500 km^2, ca. 2'000'000 inhabitants), during the years 1970-1990 (GERHARDT 1990). From this city many mycorrhizal fungi were recorded, e.g. 39 species of *Cortinarius* (in Cracow only 5 species!), 26 species of *Lactarius* (in Cracow 18), and 45 of *Russula* (in Cracow only 22). The macrofungi flora of Berlin (West) is richer and better preserved than that in Cracow.

6. CONCLUSIONS

Industrial dusts and fumes, combustion wastes, acid rains, dryness of the soil, disappearance of old trees and shrubs, trodden forests and parks, picking mushrooms for food cause disappearance of some species and a decrease in the number of fructifications in other. Most endangered are fungi associated with old natural forests, e.g. beech and riverside forests and coniferous woods, edible fungi and species with large, conspicuous fructifications (WOJEWODA 1976).

Numerous macrofungi in Cracow are threatened with extinction and are dying-out in Poland and in other European countries, they are included in red lists (e.g. ARNOLDS 1989, BENKERT 1982, OHENOJA 1985, VESTERHOLT and KNUDSEN 1990, WINTERHOFF et al. 1984, WOJEWODA 1991).

Studies made in the period 1955-1990 on macrofungi in Cracow are a basis for further observations on changes due to man's activity. The conservation of fungi in Cracow is best secured by forest reserves, where all ecosystems are protected but the protection of fungi by law has little practical significance (LAWRYNOWICZ 1988, SKIRGIELLO 1986).

The investigation on macrofungi in Cracow is going on and important results will be published.

SUMMARY

In this paper the changes in the macrofungi flora of Cracow (S Poland, 327 km^2 of area, 800'000 inhabitants) are analysed. From 1883-1990 700 species were recorded. The author carried out his studies in the period 1955-1990 and collected materials from all accessible places of the city, in each season, winter included. The changes of the flora in recent years are dramatic. The flora of macrofungi in Cracow is very poor: 13 very common species (2%), 64 common species (92%), 150 rare species (21%), 400 very rare species (58%) and probably extinct 74 species. The process of extinction of mycorrhizal fungi, connected with coniferous trees, mushrooms, fungi of natural ecosystems (e.g. riverside forests, xerothermic grasslands, peat-bogs and humid meadows), and coprobious fungi has been observed. Some rare or more sensitive fungi have stopped occuring in natural habitats and have found replacement habitats, e.g. parks, squares, old cemeteries, refuse dumps, the alleys and avenues with old trees, etc. Many synantropic fungi in Cracow have been found. There are species from other regions of Poland (e.g. of the Carpathians) or from other countries, exotic (e.g. tropical), too. These fungi grow e.g. in wooden flowerpots in flats, on balkonies and in greenhouses, on garden fences, on scaffold beams, on wooden railway and tram sleepers or on the ground. Some fungi are increased recently, e.g. *Phallus impudicus, Mutinus ravenelii* and *Schizopora carneolutea*. The macrofungi flora is poorer in Cracow than in Berlin and Greifswald (Germany), Gothenburg (Sweden) and Helsinki (Finland). The main reason of disappearance of macrofungi is probably direct or indirect impact of acid rains and other chemical pollution, e.g. toxic heavy metals, the high number

of inhabitants, new housing estates, road and railway tracts, and collection of mushrooms for food in large quantities.

REFERENCES

ARNOLDS E., 1988: The changing macromycete flora in the Netherlands. Trans.Brit.Mycol.Soc. *90(3)*, 391-406.

ARNOLDS E., 1989: A preliminary red data list of Macrofungi in Netherlands. Persoonia *14(1)*, 77-125.

CHELCHOWSKI S., 1888: Basidiomycetes of the neighbourhood of Warsaw. (In Russian). Varsh.Univ.Izvest. [*1888*], 1-112.

CHELCHOWSKI S., 1898: Basidiomycetes Polonici. (In Polish). Pam. Fizjogr. *15(3)*, 1-285.

BENKERT D., 1982: Vorläufige Liste der verschollenen und gefährdeten Pilzarten der DDR. Boletus 6, 21-32.

DUBIEL E., 1988: The vegetation of Cracow. (In Polish). In: TRAFAS K. (ed.), The atlas of Cracow city. Warszawa-Wroclaw, PPWK. Map 15.

DUBIEL E., 1991: Map of actual vegetation of the city of Cracow. (In Polish with English summary). Zesz.Nauk.Uniw.Jagiellon., Prace Bot. *22*, 121-133.

ERKKILA R. and NIEMELA T., 1986: Polypores in the parks and forests of the city of Helsinki. Karstenia *26*, 1-40.

FELLNER R., 1986: How far is the protection of the gene pool of fungi? (In Czech). Pamatky a Priroda *1[1986]*, 33-40.

FELLNER R., 1988: Effects of acid depositions on the ectotrophic stability of mountain forest ecosystems in central Europe (Czechoslovakia). In: JANSEN A.E., DIGHTON J. and BRESSER A.H.M. (eds), Proceedings of the Workshop on Ectomycorrhiza/Expert Meeting December 10-11, 1987, Berg en Dal, The Netherlands, Bilthoven. 116-121.

FRIEDRICH S., 1989: Macromycetes of Szczecin city. (In Polish, with English summary). Bad.Fizjogr.Pol.Zach., Ser.B *36*, 5-26.

GERHARDT E., 1990: Checkliste der Grosspilze von Berlin (West). Englera *13*, 1-251.

GRODZINSKA K., 1982: Plant contamination caused by urban and industrial emissions in the region of Cracow city (Southern Poland). In: BORNKAMM R., LEE J. A. and SEAWARD M.R.D. (eds.), Urban Ecology, 2nd Eur.Ecol.Symp. Blackwell Sci.Publ., Oxford/London/Edinburgh/Boston/Melbourne. 149-160.

GRODZINSKA K., GODZIK B., SZAREK G., 1987: Vegetables and soil contamination by heavy metals in allotment gardens in Krakow agglomeration (S Poland). Bull.Pol.Acad.Sci., Biol.Sci. *35(4-6)*, 112-122.

GUMINSKA B., 1985: *Mutinus ravenelii* (Berk. et Curt.) E.Fischer (*Phallales, Mycota*) - the species new to Poland. (In Polish with English summary). Zesz.Nauk.Uniw.Jagiellon., Prace Bot. *13*, 97-103.

HESS M., 1974: The climate of Cracow (In Polish with English summary). Folia Geogr., Ser.Geogr.Phys. *8*, 45-102.

KARLVALL F., 1963: Larger fungi in the Botanic Garden in Gothenburg. (In Swedish). Acta Horti Gotoburg *26*, 19-62.

KEIZER P.J., 1990: The expansion of *Schizopora carneolutea* (Basidiomycetes) in Europe, in particular in the Netherlands. Persoonia *14(2)*, 167-171.

KORNAS J. and MEDWECKA-KORNAS A., 1974: The vegetation of Cracow. (In Polish with English summary). Folia Geogr., Ser.Geogr. Phys. *8*, 153-169.

KREISEL H., 1967: Die Grosspilze des Greifswalder Botanischen Gartens. Wiss.Z.Ernst-Moritz-Arndt-Univ. Greifswald *16*, 229-329.

KREISEL H. (ed.), 1987: Pilzflora der Deutschen Demokratischen Republik. VEB Fischer, Jena. 281 p.

LAWRYNOWICZ M., 1982: Macro-fungal flora of Lodz. In: BORNKAMM R., LEE J.A. and SEAWARD M.R.D. (eds), Urban Ecology. 2nd Eur.Ecol.Symp.Blackwell Sci.Publ.Oxford-London-Edinburgh-Boston- Melbourne. 41-47.

LAWRYNOWICZ M., 1988: Threatened macrofungi and their conservation in Poland. The Mycologist *2(3)*, 113.

NESPIAK A., 1971: Die Pilze in den *Piceetum hercynicum* in Karkonosze. (In Polish with German summary). Acta mycol. *7(1)*, 87-98.

OHENOJA E., 1985: Threatened fungi in Finland. 9th Congr.Eur.Mycol., Oslo. Abstracts.

SCHROETER J., 1885-1908: Die Pilze Schlesiens. In: Cohn's, Kryptogamenflora von Schlesien, 1-2. Kerner, Breslau. 597 p.

SKIRGIELLO A., 1986: The protection of fungi in the system of nature conservation in Poland. (In Polish with English summary). Acta Univ.Lodz., Folia Sozol. *3*, 85-92.

SKIRGIELLO A., 1990: Synanthropization of the Polish mycoflora. In: SUKOPP H. et al. (eds.), Urban ecology. SPB Acad. Publ. bv., The Hague. 255-257.

SKIRGIELLO A. and DOMANSKI Z., 1981: Higher fungi of the central part of Warsaw. (In Polish with English summary). In: SEMERDZIEVA M. and SASEK V. (eds.), Report on the activity of the Commision for fungal toxicology of the Czechoslovak Scientific Society for Mycology, Prague. 40-44.

SOKOL S. and SZCZEPKA M.Z., 1987: *Mutinus ravenelii* (Berk. et Curt.) E.Fischer in Oberschlesien und einige Probleme seiner Morphologie, Bionomie und Verbreitung. Beitr. Kenntn.Pilze Mitteleur. *3*, 371-384.

STENGL-REJTHAR A. and WOJEWODA W., 1985: Expansion of the fungus *Clathrus archeri* (Berk.) Dring (Gasteromycetes) in Europe and Poland. Zesz.Nauk.Uniw.Jagiellon., Prace Bot. *13*, 105-110.

VESTERHOLT J. and KNUDSEN H., 1990: The red list of the threatened macrofungi in Denmark. (In Danish with English summary). Foreningen til Svampekundkabens Fremme, Soborg. 64 p.

WINTERHOFF W., DERBSH H., ENDERLE M., ENGEL H., FIEBIG W., FINDEISEN L., GROSS G., GROSSE-BRAUCKMANN H., HECHLER J., JAHN E., JAHN H., KNOCH D., KRIEGLSTEINER G.J., LABER D., LEFLER R., LETTAU M., LOHMEYER T., RUNGE A., SCHMITT J.A., SCHWÖBEL H., STANGL J., WENDLAND I. und WÖLDECKE K., 1984: Vorläufige Rote Liste der Grosspilze (Makromyzeten). In: BLAB J., NOWAK E., TRAUTMANN W. und SUKOPP H. (eds.), Rote Liste der gefährdeten Tier und Pflanzen in der Bundesrepublik Deutschland. Naturschutz Aktuell, Greven *1*, 162-184.

WODZICZKO A., 1911: Data to mycology of Galicia. (In Polish). Spraw.Kom.Fizjogr. *45 (3)*, 40-57.

WOJEWODA W., 1976: Disappearance of sites with macromycetes in Poland. (In Polish with English summary). Phytocoenosis *5(3-4)*, 377-386.

WOJEWODA W., 1991: The first red list of threatened macrofungi in the Polish Carpathians. (In Polish with English summary). Studia Osr.Dokum.Fizjogr.Pol.Akad.Nauk *18*, 239-261.

WOJEWODA W. and LAWRYNOWICZ M., 1986: Red list of threatened macrofungi in Poland. (In Polish with English summary). In: ZARZYCKI K. and WOJEWODA W. (eds.), List of threatened plants in Poland. PWN, Warszawa. 47-82.

WROBLEWSKI A., 1926: Champignons recueillis par M. Raciborski dans les environs de Cracovie et dans le Tatra en 1883 et 1890. (In Polish). Acta Soc.Bot.Pol. *3(1)*, 29-41.

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