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DISTRIBUTION OF POLYPORUS FUNGI IN CZAPLINEK (DRAWSKO LAKE DISTRICT, NORTH-WESTERN POLAND)

MAGDALENA KACZORKIEWICZ[1], EDWARD RATUSZNIAK[2]

[1] Technical University of Koszalin, Environmental Biology Department
ul. Śniadeckich 2, 75-453 Koszalin, Poland
e-mail: magdalena.kaczorkiewicz@wbiis.tu.koszalin.pl
[2] Pomeranian University in Słupsk, Institute of Biology Environmental Protection
ul. Arciszewskiego 22b, 76-200 Słupsk, Poland
e-mail: ratuszniak@pap.edu.pl

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Abstract: Research on the occurrence of polyporus fungi in Czaplinek were conducted in 2004 and 2005 in 6 designated regions, using the route method (area search). 363 sites containing polyporus fungi belonging to 24 species and 4 families – *Coriolaceae*, *Ganodermataceae*, *Hymenochaeteceae* and *Polyporaceae* – have been found. The most numerous among the species were *Bjerkandera adusta* (Wills. Fr.) P. Karst. (87 sites) and *Ganoderma applanatum* (Pers.) Pat. (66 sites). Three species listed on the Red List of makrofungi in Poland (*Datronia mollis* (Sommer. Fr.) Donk, *Inonotus hispidus* (Bull. Fr.) P. Karst. and *Ganoderma lucidum* (W. Curt. Fr.) P. Karst.) have been identified. It should be noted that *G. lucidum* is one of the fungi under strict legal protection.

INTRODUCTION

Polyporus fungi are one of well known types of fungi decomposing wood. They belong to *Basidiomycetes* class. They often produce imposing fruit bodies and play an important role in forests as pathogens of living trees and decomposers of dead wood [22]. Nowadays 222 species of these fungi are known in Poland [32]. Many of them, for example: *Meripilus giganteus* (Pers. Fr.) P. Karst., or *Grifola frondosa* (Dicks. ex Fr.) S.F. Gray are under protection by forest regulation [32]. Some of them, for example: *Datronia mollis* (Sommer. Fr.) Donk, *Inonotus hispidus* (Bull. Fr.) P. Karst. are on the Red List of makrofungi endangered in Poland [33].

Urban environment is essentially different from the forest phytocoenoses. Average air temperature in cities is a few degrees higher than outside, which is connected with accumulation of heat by walls of buildings, and higher air pollution caused by gases and dust [31]. There are significant fluctuations of temperature and air humidity is lower than in forests, which is not profitable for spore sprouting and fungi growing. Windiness, similarly to forests, is not strong because buildings slow down wind velocity [6]. However, in cities there are phytocoenoses (parks, gardens, cemeteries, recreational areas) with different species of trees and bushes that can be hosts of polyporus fungi.

Polyporus fungi can accumulate great concentrations of mercury and other toxic metallic elements and metalloida, such as cadmium, lead or arsenic and radionuclides [4, 5]. Compared to green plants, fungi can build up large concentration [2]. This would suggest that fungi have effective mechanism which allows them to take out toxic substances from substrate. This mechanism may be more effective in parasitic and saprotrophic fungi than in another group of fungi [24, 30].

Fungi are used to estimate heavy metals accumulation. They can be bioindicator of heavy metals accumulation in environment [26].

The research presented in this study was conducted in Czaplinek where there are two complexes of allotments, a cemetery, and two parks with different species of trees which can be hosts to fungi. The aim of this study was to analyze the occurrence of polyporus fungi in the Czaplinek area, especially, to analyze species composition and the frequency their occurrence.

CHARACTERISTICS OF THE RESEARCH AREA

Czaplinek is situated in the Drawskie Lake District (Pojezierze Drawskie), north-western Poland (symbol 314.45) which is a part of the Zachodniopomorskie Lake District (Zachodniopomorskie Pojezierze) macro region (symbol 314.4) [11].

Fig. 1. Location of the research area

The Czaplinek area is situated in the southern part of the West-Pomeranian Voivodshaft, in the area of Powiat Drawski. The terrain relief was shaped during Baltic glaciations [11, 29]. When it comes to climate the Drawskie Lake District belongs to Pomeranian district and is under the influence of the Atlantic Ocean and the Baltic Sea [16]. Diversified relief comes from various degrees of intensity of postglacial relief and genetic layout of groups of forms, as well as from terrain fragmentation by valleys into separated elevations, which cause diversification and differences of mesoclimate [7].

It is worth mentioning that the whole northern part of the Czaplinek district is a part of Drawsko and Insk Landscape Park [23].

METHODOLOGY

The research was carried out from July 2004 to October 2005 in Czaplinek in the 6 following regions:

- Region A – allotment garden area of Adam Mickiewicz;
- Region B – cemetery;
- Region C – shore of Czaplino lake;
- Region D – shore of Drawsko lake within the town;
- Region E – allotment garden area within the town;
- Region F – streets of the town including the area of two parks.

Our observation was carried out by route method of walking around and taking notes of trees, stumps and branches on the ground. After a fruit body was found the site of its occurrence was marked as a test stand. The test stand was described by an identification of the host plant inhabited by the fungus and by a description of macroscopic features that helped to identify the fungi species. To make a herbarium and some microscopic tests fruit bodies or their fragments were collected according to Domański's method [3]. The collected material was dried at room temperature and kept in paper bags. A photographic documentation of the test stands and fruitbodies' natural environment was also made.

To determine fungi species the keys of Domański [3], Ryverden and Gilberstone [22], Ratuszniak [19] were used. Species nomenclature was taken according to Ryverden and Gilberstone [22]. The results have been presented in tables and on charts below.

RESULTS

Within two years of observation 363 stands of polyporus fungi were found. Most of the stands were found in region F –163 stands; in region D – 90, in region C – 56. The number of stands in the remaining regions (A, B and E) was similar: 17, 19 and 18 respectively.

On the registered stands 24 species of polyporus fungi belonging to 4 families were identified: *Coriolaceae*, *Ganodermataceae*, *Hymenochaetaceae* and *Polyporaceae*. The alphabetic lists of species and stands number are shown in Table 1. The greatest species variety was found in region F. Among 24 species generally identified region F contained as many as 18. Half of the identified species occurred in region D (11), and in the remaining regions – A, B, C and E: 7, 6, 9 and 7 respectively.

The most frequent species were: *Bjerkandera adusta* (Wills. Fr.) P. Karst. found on 87 stands, *Ganoderma applanatum* (Pers.) Pat. – on 66 and *Phellinus igniarius* (L. Fr.) Quel – on 51. The rarest species that occurred only on one of the stands were: *Daedaleopsis confragosa* (Bolt. Fr.) Schroet., *Piptoporus betulinus* (Bull. Fr.) P. Karst., *Inonotus hispidus* (Bull. Fr.) P. Karst. and *Daedalea quercina* (L. Fr.).

Three of the identified species occurred very rarely and can be found on the Red List of makrofungi endangered in Poland [33, 35]. These were: *Datronia mollis*, *Inonotus hispidus* (Bull. Fr.) P. Karst. and *Ganoderma lucidum* (W. Curt. Fr.) P. Karst. The last one also belongs to funguses under strict legal protection [21].

Table 1. Taxonomic specification of denoted species of polypore fungi with regard to their occurrence and number of sites

FAMILY / Sort	Test stands number						
	Region A	Region B	Region C	Region D	Region E	Region F	Total
CORIOLACEAE							
Bjerkandera adusta (Wills. Fr.) P. Karst.	1	9	14	9	2	51	86
Bjerkandera fumosa (L. Fr.)	–	–	4	–	–	7	11
Daedalea quercina (L. Fr.)	1	–	–	–	–	–	1
Daedaleopsis confragosa (Bolt. Fr.) Schroet.	–	–	–	–	1	–	1
Datronia mollis (Sommer. Fr.) Donk	–	1	1	2	–	2	6
Fomes fomentarius (L. Fr.) Krickx	–	–	–	7	–	2	9
Fomitopsis pinicola (Schwartz Fr.) P. Karst.	4	–	–	–	6	2	12
Gleophyllum sepiarium (Wulf. Fr.) P. Karst.	–	–	–	–	1	1	2
Heterobasidion annosum (Fr.) Bref.	–	–	1	1	–	1	3
Laetiporus sulphureus (Bull. Fr.) Murr.	1	–	7	4	–	–	12
Piptoporus betulinus (Bull. Fr.) P. Karst.	1	–	–	–	–	–	1
Trametes gibbosa (Pers.) Fr.	–	–	1	–	–	10	11
Trametes hirsuta (Fr.) Pilat	2	–	–	11	4	4	21
Trametes ochracea (Pers.) Gilb & Ryvarden	–	–	–	–	–	4	4
Trametes pubescens (Schumach. Fr.) Pilat	–	2	2	7	2	4	17
Trametes versicolor (L. Fr.) Pilat	–	2	–	–	2	3	7
GANODERMATACEAE							
Ganoderma applanatum (Pers.) Pat.	–	1	4	5	–	56	66
Ganoderma lucidum (W. Curt. Fr.) P. Karst.	–	–	–	–	–	2	2
HYMENOCHAETACEAE							
Inonotus hispidus (Bull. Fr.) P. Karst.	–	–	–	1	–	–	1
Inonotus radiatus (Sow. Fr.) P. Karst.	–	–	–	6	–	–	6
Phellinus igniarius (L. Fr.) Quel.	–	–	22	28	–	1	51
Phellinus pomaceus (Pers.) Maire	7	–	–	–	–	5	12
Phellinus robustus (P. Karst.) Bourdot & Galzin	–	–	–	–	–	3	3
POLYPORACEAE							
Polyporus varius (Fr.)	–	4	–	9	–	5	18
Total	17	19	56	90	18	163	363

DISCUSSION

Flora of urban environments is under strong anthropopressure, and the species composition of trees and bushes living there differs significantly from forest phytocenoses. Trees distribution and their density are also diversified, which is closely connected with a possibility of spreading infections. Infection efficiency by pathogenic fungi depends, to a large extent, on a plant's surface because this is the first contact and further reaction place between a pathogen and a plant [8]. In the case of polyporus fungi, the age of the host is one great significance. Old trees are more susceptible to infection than younger ones [13].

Region B is an area of the communal cemetery. Polyporus fungi occur here only on stumps of cut down trees that are a perfect place of infection thanks to big surface of a cut. Living trees are tended by city service and places where branches were cut off are protected against fungi infections.

Region F is the one where the highest number of fungi stands was recorded. This region comprises mainly city parks with a great amount of old trees. Due to the closeness of lakes, great humidity as well as trees density it favors the spread of spores and infections.

The regions A and E are areas of allotments gardens and the density of fungi stands occurring there was similar. It was probably connected with the similar age of trees. Trees are tended by owners which mean that if pathological symptoms appeared, trees like these or branches were removed. That is why the number of stands was not great.

The regions C and D include lake shores and they are very similar as regards humidity, trees species and also inhabiting fungi. Trees growing in that vicinity are old and often damaged by wind and grow close to one another. The region D had more species of fungi and more numerous probably because it is a bigger area in comparison to the region C. The neighborhood of forests could also have had some influence as fungi spores could easily find the way to the urban area.

Research on the influence urban environments and anthropopression on the occurrence of polyporus fungi were carried out sporadically. Adamczyk and Ławrynowicz [1] claim that first data on fungi appearing in urban areas go back to the second half of the 20th century. The oldest information concerns cities such as Gdańsk, Jelenia Góra and Wrocław [1]. It only briefly mentions the occurrence in one of those cities of one or just a few fungi species.

Research on the occurrence of polyporus fungi in urban areas of Pomerania: in Gdynia, Starogard Gdański and Sztum were carried out by Milewska and Ratuszniak [14]. The number of registered stands in individual cities was 169, 195 and 107 respectively and the total number of 25 species of polyporus fungi was recorded.

In our own research the number of stands in Czaplinek (363) outnumbered the number of stands in each of the above mentioned cities but the number of the determined species was similar. The species composition of the fungi determined by the above authors and the species obtained in our own research are shown in Table 2. Among the species found in Czaplinek as many as 6 did not occur in any of the cities researched by Milewska and Ratuszniak; however, 6 species, from the ones determined by the above researchers, did not occur in Czaplinek.

Table 2. Specification of polyporus funguses occurring only in Czaplinek or only in research by [14]

Species found only in Czaplinek	Species not found in Czaplinek
Bjerkandera fumosa	*Antrodia serialis* (Fr.) Donk
Daedalea quercina	*Gleophyllum odoratum* (Fr.) Sing
Datronia mollis	*Oligoporus stipticus* (Pers.) Gilb. & Ryvarden
Ganoderma lucidum	*Trametes suaveolens* (L. ex Fr.) Fr.
Polyporus varius	*Trichaptum abietinum* (Pers. Fr.) Ryv.

It is worth pointing out that among species determined in Czaplinek, *Ganoderma lucidum* is the one which belongs to the list of fungi legally protected, and *Datronia mollis* is on the Red List of Makrofungi endangered in Poland. When it comes to the species not found in Czaplinek, all of them except *Trametes suaveolens*, were saprophytes or weak parasites of coniferous trees. In the research region of Czaplinek coniferous trees occur sporadically and probably that is the reason why fungi preferring such types of hosts were not found.

In years 2002 and 2003 in Słupsk Ratuszniak found number of 160 stands, which belong to 20 species of polyporus fungi. Among fungi which didn't appear in Czaplinek there were noted such species as: *Meripilus giganteus* (Pers. Fr.) P. Karst. – 5 stands, *Oxyporus populinus* (Schumach. Fr.) Donk, *Inonotus cuticularis* (Bull. Fr.) Karst. [20]. It is worth pointing out that the surface area of Słupsk is four times bigger than the surface area of Czaplinek and quantity of observed stands were almost three times less than in Czaplinek.

The influence of industrial pollution on the growth of fungi diseases spreading among trees and forest stands began to be researched in detail from the beginning of the 1970's. The research involved trees diseases occurring in the closest neighborhood of industries emitting different gas and dust pollutants [10]. According to Norden [15] we know very little about how saprophyte fungi respond to changes in urban environment.

Sokół and Piątek indicate synantrophication of fungi in cities [18, 27]. In urban environment many fungi change their ecological preference, e.g. they use another substance [28]. Sokół after Wojewoda presented the phenomenon of fruit bodies nanizm in cities and another urban area [28].

The town of Czaplinek is situated in the Drawski district in which, according to Voivodeship Inspectorate for Environmental Protection in Szczecin [12], pollutants and environmental dangers do not appear or they occur on a minimal scale. Probably for this reason fungi occurred in Czaplinek in years 2004 and 2005 were in typical size and appeared on their typical hosts. In 2002–2004 the Inspectorate carried out air quality research in which they studied the concentration of sulphur dioxide, nitrogen oxide and ozone. The research showed that all these pollutants did not exceed acceptable standards introduced by the Ministry of Environment in the decree from the 5th of December, 2002 on the reference values of substances in the air. Some increase of pollutants can be observed during heating season, which is caused by energy sector. In the town there are seven small factories and three boiler houses. They emit insignificant amounts of pollution. Some, however insignificant, concentration of nitrogen oxides can be observed in summer, which is generally connected with transport and heavier traffic in the tourist season. Transport causes emission of about 69% of lead, 66% of carbon oxides, 31% of ozone, 43% of carbon oxide and 20% of insoluble pollutants [19].

CONCLUSIONS

1. Research carried out in 2004 and 2005 in 6 regions of the town of Czaplinek helped to locate 363 stands of polyporus fungi belonging to 24 species within the following families *Coriolaceae*, *Ganodermataceae*, *Hymenochaetaceae* and *Polyporaceae*.
2. The region F was the richest in species variety and the number of fruit bodies. 163 stands of funguses belonging to 18 species were located. The fewest fruit bodies were found in region A (17 stands with 7 species).
3. The most numerous species of polyporus fungi were: *Bjerkandera adusta*, found on 87 stands and *Ganoderma applanatum* – 66 stands. The least frequent were *Daedalea quercina*, *Inonotus hispidus*, *Daedaleopsis confragosa* and *Piptoporus betulinus* – each only on 1 stand.
4. Three species of protected fungi *Datronia mollis*, *Inonotus hispidus* and *Ganoderma lucidum* that are on the Red List of Makrofungi endangered in Poland were found. The latter is also on the list of fungi under strict legal protection.
5. Significant numbers of stands in the region E (near Drawsko Lake) is connected with high humidity, which favors fungi infection.
6. There data can suggest that polyporus fungi may be used as bioindicator.

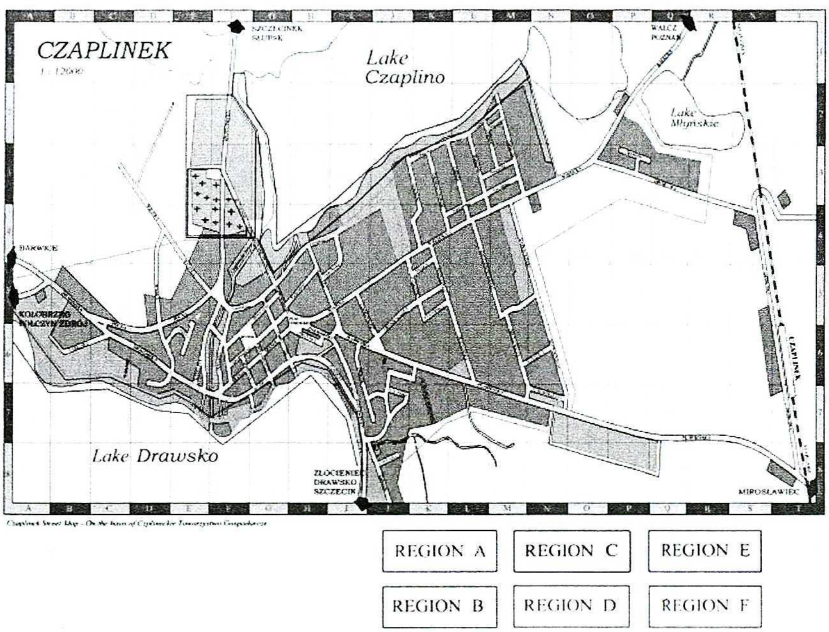

Fig. 2. Czaplinek street map devised on research regions

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ROZMIESZCZENIE GRZYBÓW POLIPOROIDALNYCH W CZAPLINKU (POJEZIERZE DRAWSKIE, PÓŁNOCNO-WSCHODNIA POLSKA)

Badania nad występowaniem grzybów poliporoidalnych na terenie Czaplinka przeprowadzono w latach 2004 i 2005 w 6 wyznaczonych rejonach, stosując metodę marszrutową. Zlokalizowano ogółem 363 stanowiska grzybów poliporoidalnych należących do 24 gatunków w obrębie czterech rodzin: *Coriolaceae*, *Ganodermataceae*, *Hymecheateceae* i *Polyporaceae*. Najliczniej występującymi gatunkami były *Bjerkandera adusta* (87 stanowisk) i *Ganoderma applanatum* (66 stanowisk). Stwierdzono obecność 3 gatunków znajdujących się na *Czerwonej liście grzybów wielkoowocnikowych zagrożonych w Polsce* (*Datronia mollis*, *Inonotus hispidus* i *Ganoderma lucidum*), przy czym *G. lucidum* znajduje się w wykazie gatunków grzybów objętych ochroną ścisłą.