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Habitat conditions of occurrence of *Ptychoverpa bohemica* (Krombh.) Boud. (Morchellaceae) in anthropogenic habitats in southern Poland

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Abstract: The paper presents information about habitat conditions of occurrence of the *Ptychoverpa bohemica* (Krombh.) Boud. fungus in man-made habitats in Silesian Upland in southern Poland. Soil samples were collected from 5 sites in order to measure the contents of organic carbon, nitrogen, carbon/nitrogen ratio and percentage of organic matter, as well as the values of pH and electric conductivity. Lists of plants associated with *Ptychoverpa bohemica* were also prepared. Results of the investigation show that pH values of analysed soils are neutral to slightly acidic, they show negligible salinity, and the content of organic carbon, nitrogen and organic matter are higher in their upper levels. The floristic composition of patches with *Ptychoverpa bohemica* usually consists of species which are common in urban areas, such as apophytes and anthropophytes, for example: *Betula pendula*, *Brachythecium rutabulum, Epipactis helleborine, Pinus sylvestris, Populus tremula, Quercus robur, Salix caprea* and *Sorbus aucuparia*.

Key words: species diversity, soil properties, protected species, man made habitats

Introduction

Ptychoverpa bohemica (Krombh.) Boud. (Morchellaceae) was a rare species, placed on 'Red list of fungi in Poland' (2006) and strictly protected by the law until 2014 (Fig 1). In the recent years, many sources of information about the occurrence of this species have appeared, mainly on www-pages (e.g. http://www.grzyby.pl/rejestr-grzybow-chronionych-i-zagrozonych.htm). The species was found in many places, mostly in southern and central Poland, sometimes abundantly (hundreds of fruit-bodies). Its sites are located in natural sites or ones slightly changed by human activity (forests, thickets, parks) (Kujawa & Gierczyk 2010, 2011a, 2011b, 2012, Nabożny 2004). Probably it was the information that caused *P. bohemica* to be moved to a lower protection category in 2014 - partly protected (Regulation - 2014). The investigation carried out in the vicinity of Katowice (Silesian Upland) shows that this species also appears in habitats strongly affected by human impact or created by people, such as railway embankments, excavations of mineral sources, strongly degenerated managed forest and post-industrial areas. The goal of this paper is the description of habitat conditions of the occurrence of *Ptychoverpa bohemica* in anthropogenic sites.

Materials and methods

Field investigation was carried out in spring of 2013 and 2014. Samples were collected from 5 sites. From each soil sample, the upper (humic) and the lower (mineral) levels were separated for the purpose of study. The upper level comprises soil to about 5 cm depth, whereas the lower one about 5-10 cm. Lists of plants occurring together with *Ptychoverpa bohemica* were also made. Liverwort names follow Klama (2006), mosses Ochyra *et al.* (2003) and vascular plants Mirek *et al.* (2002).

In the sampled soil, the following parameters were measured: content of organic carbon (Tiurin method), nitrogen (Kjeldahl method), carbon/nitrogen ratio and percentage of organic matter (Tiurin method), as well as pH values and electric conductivity (EC) (Ostrowska *et al.* 1991; Bednarek *et al*. 2004).

Soil conditions and floristic composition of particular patches with *Ptychoverpa bohemica* were compared using cluster analysis, UPGMA with Euclidean distance for soil data and Ward's method with Jaccard's distance for floristic composition (package simba in R project).

Characteristics of the plots

1. Katowice (Kt), between motorway A4 and Gospodarcza Street, 50º14'37"N 19º03'32"E, strongly anthropogenicly changed mixed forest.
2. Katowice-Szopienice (Sz), 50º16'26"N 19º05'54"E, the bottom of abandoned sandpit overgrown by birch and aspen forest south-west of the Borki reservoir (in text as Szopienice).
3. Chorzów-Batory, Niedźwiedziniec (B), 50º15'44"N 18º56'54"E, a slope near closed down railway line overgrown by thicket (in text as Batory).
4. Ruda Śląska-Kochłowice (Ko), the Radoszowka Street, 50º15'18"N 18º55'35"E, margin of thicket near railway embankment (in text as Kochłowice; Fig 2).
5. Ruda Śląska-Halemba (H), the Szyb Artura Street, 50º15'15"N 18º52'32"E, a post-industrial area (closed down mine shaft) overgrown by birch and aspen forest, and thicket (in text as Halemba).

Results and discussion

Soils analysis

Information about the content of organic carbon, nitrogen, carbon/nitrogen ratio and the percentage of organic matter, as well as pH and EC values in samples analysed, are set in table 1.

Tab 1: Content of organic carbon, nitrogen, carbon/nitrogen ratio, percentage of organic matter and values of pH and EC.

Sites	C org%	N%	C/N	% organic matter	pH in H_2O	pH in KCl	EC [µS/cm]
Kt1	3.10	0.40	7.75	5.35	5.40	4.55	192
Kt2	1.67	0.27	6.23	2.87	5.52	4.64	112
Sz1	5.34	0.24	22.48	9.20	5.10	4.17	127
Sz2	0.59	0.05	11.67	1.02	4.93	3.59	69
B1	5.15	0.3	17.16	8.87	6.72	6.04	253
B2	4.27	0.32	13.53	7.36	6.51	5.82	213
Ko1	0.38	0.14	2.64	0.65	6.49	5.72	98
Ko2	0.84	0.07	12.42	1.45	6.24	5.64	84
H1	3.12	0.25	12.37	5.37	6.59	5.89	148
H2	0.58	0.05	11.68	1.00	6.38	5.58	103

Explanations: **Kt1** - Katowice, upper level, **Kt2** - Katowice, lower level, **Sz1** - Szopienice, upper level, **Sz2** - Szopienice lower level, **B1** - Batory, upper level, **B2** - Batory, lower level, **Ko1** - Kochłowice, upper level, **Ko2** - Kochłowice, lower level, **H1** - Halemba, upper level, **H2** - Halemba, lower level.

The pH values of analysed soils are neutral to slightly acidic and vary (pH in H_2O) from 6,72 in the upper level in Batory to 4.93 in the lower level in Szopienice (pH in KCl 5.82 and 3.59, respectively).

Electric conductivity ranges from 253 µS/cm in the upper level in Batory to 84 µS/cm in the lower level in Kochłowice. These values show negligible salinity of analysed soils, which is not toxic for fungi and does not change their physical properties (Witczak & Adamczyk 1994).

The content of organic carbon is higher in the upper levels. An exception is Kochłowice, where in the lower level the content is over 2 times higher than in the upper one. The content of nitrogen is also higher in the upper levels. It is slightly lower only in Batory. Similarly,

the C/N ratio is higher in the upper levels. An interesting situation occurs in Kochłowice, where the ratio is almost 6 times higher in the lower level. The percentage of organic matter in the upper levels is higher, with the exception of Kochłowice, where it is over 2 times smaller (Tab 1).

Considering the soil data, site number 3 (Chorzów-Batory) is the most unique. It is located on the old railway embankment, made probably of admixture of slag and waste rock. The remaining sites are arranged in two pairs. Szopienice (2) and Kochłowice (4) are located on sandy soil, whereas Katowice (1) and Halemba (5) are situated on soil in forest and thicket communities (Fig 3).

Floristic composition of patches

Table 2 contains lists of plants accompanying *Ptychoverpa bohemica*. In all sites, they are plants common in urban areas, such as apophytes and anthropophytes, which occur in habitats affected by human activity or in overgrown abandoned places. The constant element is *Betula pendula*, which occurs frequently, and for example, *Brachythecium rutabulum, Epipactis helleborine, Pinus sylvestris, Populus tremula, Quercus robur, Salix caprea* and *Sorbus aucuparia*. Altogether, the list of species accompanying *Ptychoverpa bohemica* comprises 11 bryophytes and 68 vascular plants.

Tab 2: Floristic composition of patches with incidence of *Ptychoverpa bohemica*.

Species name	Sites				
	1	2	3	4	5
Vascular plants					
Achillea millefolium	-	+	-	+	-
Agrostis capillaris	-	+	-	-	-
Anthriscus sylvestris	-	-	-	-	+
Cardaminopsis arenosa	-	-	-	-	+
Arrhenatherum elatius	-	-	+	+	-
Artemisia vulgaris	-	-	-	-	-
Athyrium filix-femina	+	-	-	-	-
Betula pendula	+	+	+	+	+
Calamagrostis epigejos	-	-	-	+	-
Cardaminopsis halleri	+	-	-	-	+
Carex hirta	-	-	-	-	+
Dactylis glomerata	-	-	-	+	-
Deschampsia caespitosa	+	+	-	-	-
Deschampsia flexuosa	+	-	-	-	-
Dryopteris carthusiana	+	-	-	-	-

Species name	Sites				
	1	2	3	4	5
Vascular plants					
Epilobium montanum	-	-	-	-	+
Epipactis helleborine	+	-	+	+	+
Equisetum arvense	-	-	-	+	+
Fagus sylvatica	-	-	+	-	-
Festuca rubra	-	-	+	-	-
Festuca gigantea	-	-	-	-	+
Festuca sp.	-	+	-	-	-
Fragaria vesca	-	-	-	-	+
Frangula alnus	+	-	-	-	-
Fraxinus excelsior	-	-	-	-	+
Galium aparine	-	-	-	-	+
Geum urbanum	-	-	-	-	+
Hieracium laevigatum	+	-	+	-	-
Hieracium sabaudum	-	+	-	-	-
Holcus lanatus	-	-	-	+	+
Impatiens parviflora	-	-	-	-	+
Leontodon hispidus	-	+	-	-	-
Listera ovata	-	-	-	-	+
Luzula campestris	-	-	-	-	+
Luzula pilosa	+	-	-	-	-
Lysimachia vulgaris	-	-	-	+	+
Melandrium album	-	-	-	-	+
Molinia caerulea	+	-	-	-	-
Oxalis acetosella	+	-	-	-	-
Picea abies	+	-	-	-	-
Pinus sylvestris	+	+	-	+	-
Plantago lanceolata	-	+	-	-	-
Poa pratensis	-	-	+	-	-
Poa trivialis	-	-	-	-	+

Species name	Sites				
	1	2	3	4	5
Vascular plants					
Populus tremula	-	+	+	-	+
Pteridium aquilinum	+	-	-	-	-
Quercus robur	+	+	+	+	-
Quercus rubra	+	-	+	+	-
Ranunculus acris	-	+	-	+	-
Ranunculus repens	-	-	-	-	+
Robinia pseudoacacia	-	-	-	-	+
Rosa sp.	-	-	-	+	-
Rubus caesius	-	-	-	-	+
Rubus plicatus	-	-	-	-	+
Rumex obtusifolius	-	-	-	-	+
Salix alba	-	-	-	+	-
Salix caprea	-	+	+	-	+
Salix rosmarinifolia	-	+	-	-	-
Sambucus nigra	-	-	-	-	+
Solidago gigantea	-	-	-	+	+
Sorbus aucuparia	+	+	-	+	-
Taraxacum officinale	-	-	-	-	+
Trifolium repens	-	+	-	+	-
Urtica dioica	-	-	-	-	+
Vaccinium myrtillus	-	-	-	-	-
Valeriana officinalis	-	-	-	+	-
Vicia cracca	-	-	+	-	+
Vicia tetrasperma	-	-	-	+	-
Bryophytes					
Amblystegium serpens	-	-	+	-	-
Brachytheciastrum velutinum	-	-	+	-	-
Brachythecium albicans	-	+	-	-	-
Brachythecium rutabulum	+	-	-	+	+
Brachythecium salebrosum	-	+	-	-	-

Species name	Sites				
	1	2	3	4	5
Bryophytes					
Calliergonella cuspidata	-	-	-	-	+
Ceratodon purpureus	-	-	+	+	-
Eurhynchium striatum	+	-	-	-	-
Lophocolea heterophylla	-	-	+	-	-
Plagiomnium affine	-	-	-	-	+
Pleurozium schreberi	+	+	-	-	-

Explanations: **1** – Katowice, **2** – Szopienice, **3** – Batory; **4** – Kochłowice, **5** – Halemba

Fig 1: Fruit body of *Ptychoverpa bohemica* in Chorzów-Batory (Photo by A. Stebel, 5 May 2013).

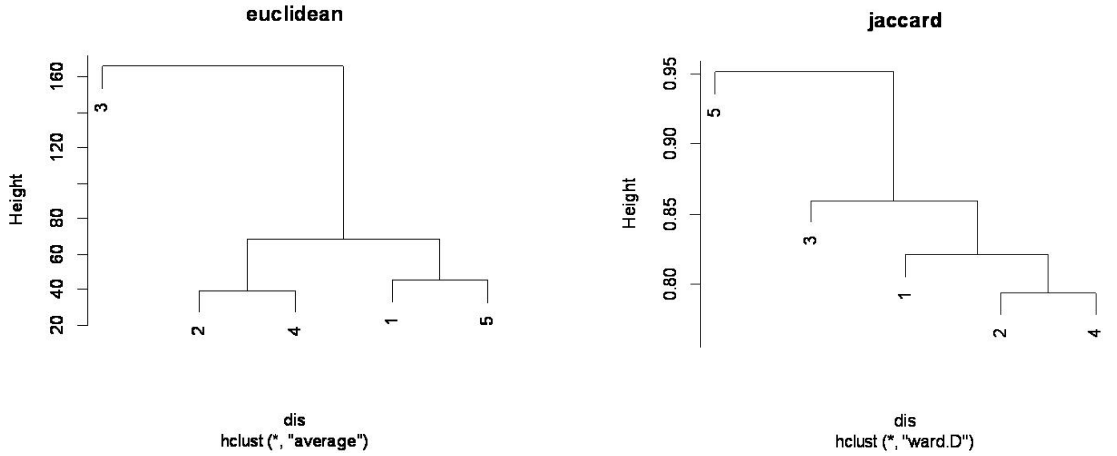
The analysis of floristic composition of patches with *Ptychoverpa bohemnica* shows that the most separate site is Halemba (5), which is the richest in species. The most similar (also considering soil data) are the following sites: Szopienice (2) and Kochłowice (4), both located on sandy soil.

Generally, the analyses considering soil data and floristic composition of patches do not show the same similarity (Fig 4).

The phenomenon of expansion of previously rare and endangered species on anthropogenic changed habitats is observed in many groups of organisms but the reasons are unknown in many cases. Very frequently, this way of spreading concerns alien species. Among fungi, the exam-

ples could be *Clathrus archeri* (Berk.) Dring, *Clathrus ruber* P. Micheli ex Pers. and *Mutinus ravenelii* (Berk. & M.A. Curtis) E. Fisch. in Europe (Szczepkowski & Obidziński 2012.) or *Amanita phalloides* (Vaill. ex Fr.) in some regions of North America (Pringle *et al.* 2009). Also, some rare native species can appear in this type of habitat. For example, many rare and endangered plant species occur in abandoned sandpits and quarries (e.g. Błońska 2010, Czylok & Szymczyk 2009, Stebel 2006). Information about the occurrence of rare species appears fairly frequently, but data concerning their habitat conditions are published considerably rarely (e.g. Stebel & Błońska 2012). Due to lack of information, it is impossible to compare habitat conditions of *Ptychoverpa bohemica* from its other sites, therefore this problem needs further studies.

Fig 2: View on the site of *Ptychoverpa bohemica* in Ruda Śląska-Kochłowice (Photo by A. Stebel, 5 May 2013).



Figs 3–4: 3 (left): Cluster analysis of soil data (UPGM method, Euclidean distance); **4 (right):** Cluster analysis of patch floristic composition data (Ward's method, Jaccard's distance).

References

Bednarek R., Dziadowiec H., Pokojska U. & Prusinkiewicz Z. (2004): Badania ekologiczno-gleboznawcze. Wydawnictwo Naukowe PWN, Warszawa, 343 pp.

Błońska A. (2010): Anthropogenic sites on Silesian Upland as habitats of rare and endangered marsh species of the *Scheuchzerio-Caricetea nigrae* class (North. 1937). R. Tx. 1937. – Water-Environment-Rural Areas 10 - 1(29): 7-19.

Chlebicki A. (1997): Nowe stanowiska smardzówki czeskiej *Verpa bohemica*, okratka australijskiego *Clathrus archeri* i czasznicy olbrzymiej *Calvatia gigantea* na Dolnym Śląsku. – Chrońmy Przyrodę Ojczystą 53(1): 104-110.

Czylok A. & Szymczyk A. (2009): Sand quarries as biotopes of rare and critically endangered plant species. In: Mirek Z. & Nikiel A. (eds): Rare, relict and endangered plants and fungi in Poland. Pp. 187-192. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

Klama H. (2006): Systematic catalogue of Polish liverwort and hornwort taxa. Pp. 83-100. In: Szweykowski J. An annotated checklist of Polish liverworts and hornworts. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, 114 pp.

Kujawa A. & Gierczyk B. (2010): Rejestr gatunków grzybów chronionych i zagrożonych. Część III. Wykaz gatunków przyjętych do rejestru w roku 2007. – Przegląd Przyrodniczy 21(1): 8-53.

– (2011a): Rejestr gatunków grzybów chronionych i zagrożonych. Część IV. Wykaz gatunków przyjętych do rejestru w roku 2008. – Przegląd Przyrodniczy 22(1): 17-83.

– (2011b): Rejestr gatunków grzybów chronionych i zagrożonych. Część V. Wykaz gatunków przyjętych do rejestru w roku 2009. – Przegląd Przyrodniczy 22(4): 16-68.

– (2012): Rejestr gatunków grzybów chronionych i zagrożonych. Część VI. Wykaz gatunków przyjętych do rejestru w roku 2010. – Przegląd Przyrodniczy 23(4): 3-59.

Mirek Z., Piękoś-Mirkowa H., Zając A. & Zając M. (2002): Flowering plants and pteridophytes of Poland. Institute of Botany, Polish Academy of Sciences, Kraków, 442 pp.

Nabożny P. (2004): Nowe stanowisko smardzówki czeskiej *Ptychoverpa bohemica* (Krombholtz) Schroet. na Pogórzu Ciężkowickim. – Wszechświat 105: 4-6.

Ochyra R., Żarnowiec J. & Bednarek-Ochyra H. (2003): Census Catalogue of Polish Mosses. Institute of Botany, Polish Academy of Sciences, Kraków, 372 pp.

Ostrowska A., Gawliński S. & Szczubiałka Z. (1991): Metody analizy i oceny właściwości gleb i roślin. Instytut Ochrony Środowiska, Warszawa, 334 pp.

Pringle A., Adams R.I., Hugh B. Cross H.B. & Bruns T.D. (2009): The ectomycorrhizal fungus *Amanita phalloides* was introduced and is expanding its range on the west coast of North America. – Molecular Ecology 18: 817-833.

Stebel A. (2006): New bryophyte data for mineral workings in Upper Silesia (Poland). In: In: Nowak A. & Hebda G. (eds): Biodiversity of quarries and pits. Pp. 71-81. Opole Scientific Society – 3rd Department of Natural Sciences, Opole-Górażdże.

Stebel A. & Błońska A. (2012): *Moerckia hibernica* (Marchantiophyta) in anthropogenic habitats in southern Poland. – Herzogia 25(1): 113-117.

Szczepkowski A. & Obidziński A. (2012): Obce gatunki sromotnikowatych Phallaceae w lasach Polski. – Studia i Materiały CEPL w Rogowie. Zeszyt 33(4): 279-295.

Witczak S. & Adamczyk A. (1994): Katalog wybranych fizycznych i chemicznych wskaźników zanieczyszczeń wód podziemnych i metod ich oznaczania. Tom I. – Biblioteka Monitoringu Środowiska, PIOŚ, Warszawa, 111 pp.

Wolfe B.E., Kuo M. & Pringle A. (2012): *Amanita thiersii* is a saprotrophic fungus expanding its range in the United States. – Mycologia 104(1): 22-33.

http://www.grzyby.pl/rejestr-grzybow-chronionych -i-zagrozonych.htm

Regulation of the Minister of the Environment (Poland) of 16 October 2014 on species of fungi under protection. Journal of Laws 2014, item 1409 (in Polish).

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