

Distribution, ecology and fructification of a rare ascomycete, *Pseudorhizina sphaerospora*, in the Czech Republic and its habitats in Europe

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Pseudorhizina sphaerospora (Ascomycota, Pezizales, Discinaceae) belongs to the rarest fungi of the Czech Republic (CR). At each of the three known localities its occurrence is quite different in character. There is a historical locality where the species was observed only once a long time ago (Plešný = Plechý Mts.), a locality with continuous occurrence for more than 80 years (Boubínský prales virgin forest) and a new locality, where the fungus was found in 2005 (Žofínský prales virgin forest). All records of *P. sphaerospora* in the CR originate exclusively from montane virgin forests representing rare remnants of natural vegetation almost untouched by man. However, in Nordic countries, Switzerland, Germany and Slovakia the species is known from man-made or man-influenced habitats. It seems that *P. sphaerospora* does not prefer natural forests but either cold and humid climatic conditions or dead wood with a stable high water content. Such conditions are met in Nordic countries, in high mountains, in virgin forests with a stable humid mesoclimate and in dead conifer woods supplied by water from streams, etc.

Key words: natural forests, virgin (primaeval) forests, man-made habitats, cold climate, mountains

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Pseudorhizina sphaerospora (Ascomycota, Pezizales, Discinaceae) patří k nejvzácnějším houbám České republiky. Na každé ze tří známých lokalit má její výskyt zcela odlišný charakter. Plešný (= hora Plechý) představuje historickou lokalitu, kde byl druh nalezen jen jednou před mnoha desetiletími. V Boubínském pralesi je výskyt dokumentován průběžně už přes 80 let. V Žofínském pralesi byla houba nalezena teprve v roce 2005. Všechny nálezy *P. sphaerospora* v ČR pocházejí výlučně z horských pralesovitých porostů, které představují vzácné zbytky původní vegetace téměř nedotčené člověkem. Naproti tomu nálezy ze Skandinávie, Švýcarska, Německa a Slovenska pocházejí většinou z člověkem vytvořených nebo ovlivněných stanovišť. *P. sphaerospora* tedy nepreferuje přirozené lesy, ale zřejmě prostředí s chladným a vlhkým klimatem nebo dřevo s vysokým a vyrovnaným obsahem vody. Takové podmínky existují ve Skandinávii, ve vysokých horách, v pralesovitých porostech majících stabilní a vlhké mezoklima a splňuje je i mrtvé dřevo jehličnanů syčené vodou potoků apod.

INTRODUCTION

Pseudorhizina sphaerospora (Peck) Pouzar (Ascomycota, *Pezizales*, *Discinaceae*) belongs to the rarest fungi of the Czech Republic (CR). Its study has a long history in this country. The fungus was first reported by Kavina (1924), who described it as the new species *Gyromitra gabretae* Kavina. Kavina found it in the Boubínský prales virgin forest on a slope of Mt. Boubín in the Šumava Mts. Later, Kavina (1926) reported a find by A. Frič from Plešný (= Mt. Plechý) in the Šumava Mts., where the species has never been found later.

The occurrence of *P. sphaerospora* in the Boubínský prales virgin forest is continuous to date. Rich material from this locality was used for taxonomic and ecological studies by Velenovský (1934: p. 391-392, tab. 28: fig. 1; as *Ochromitra gabretae*), Herink (1955, as *Helvella gabretae*) and Pouzar (1961). Colour photographs from Boubínský prales were published in works by Kluzák et al. (1985), Antonín and Bieberová (1995), Beran and Tondl (1997), Papoušek (2004), Holec (2003), Albrecht et al. (2003: 677) and in a book titled “Houby, česká encyklopedie” (2003: p. 75). From the conservational viewpoint, *P. sphaerospora* is considered a critically endangered species both in the Red Book and Red List of fungi of the CR (Kotlaba et al. 1995, Holec and Beran 2006). Consequently, it is protected by law in the CR (Antonín and Bieberová 1995). Some recent finds from Boubínský prales were published by Holec (1998, 1999). There are also unpublished collections in the PRM and CB herbaria. In 2005, the second author found it also in the Žofínský prales virgin forest in the Novohradské hory Mts.

The species is included in the Red List of 7 European countries. Ecological data from Norway, Sweden, Finland (e.g. Dissing 2000), Switzerland (Hotz 1961, Rahm 1970, Stappung 1985) and Germany (Benkert 2000) show that *P. sphaerospora* occurs also in man-made and man-influenced habitats.

The aim of this paper is to evaluate the long-term occurrence and fructification of *P. sphaerospora* in the Boubínský prales virgin forest, to provide details on the first find in the Žofínský prales virgin forest and to discuss the fact that the species is reported from virgin forests in some countries and from man-made habitats in other countries.

MATERIAL AND METHODS

The recent occurrence of *Pseudorhizina sphaerospora* in the Boubínský prales virgin forest was studied during irregular visits by the first author in the years 1997-2006 (0-2 visits a year). However, the search was not systematically devoted to the species and was not performed in the whole area of the Boubínský prales National Nature Reserve. The study of mycobiota of the Žofínský prales vir-



Fig. 1. *Pseudorhizina sphaerospora*, Boubínský prales virgin forest, decaying trunk of *Picea abies* (see Fig. 3), young fruitbody, 21 May 2005, photo by J. Holec (fore details see Tab. 1).



Fig. 2. *Pseudorhizina sphaerospora*, Boubínský prales virgin forest, decayed wood in soil under fallen trunk of *Picea abies*, mature fruitbody, 15 June 2005, photo by J. Holec (fore details see Tab. 1).



Fig. 3. Boubínský prales virgin forest, decaying trunk of *Picea abies* – substrate of *P. sphaerospora*. Habitat of the records documented by Fig. 1 and Fig. 2. Photo by J. Holec, 21 May 2005.



Fig. 4. *Pseudorhizina sphaerospora*, Žofínský prales virgin forest, 4 June 2005, CB 14536. Photo by T. Papoušek. The fruitbody is photographed not in the original site but in a site resembling it.

gin forest by the second author was more intensive and had the character of a monitoring study (10 visits a year in the periods 1991-1995 and 2004-2005, study of all phenologic aspects of fungi during the year, over the entire area of the nature reserve).

Voucher specimens are deposited in the herbaria PRM, CB and BRNM.

Abbreviations: BP: Boubínský prales virgin forest, CR: Czech Republic, MTB: grids of Central European mapping system, ŽP: Žofínský prales virgin forest.

RESULTS AND DISCUSSION

Pseudorhizina sphaerospora (Peck) Pouzar 1961

Basionym: *Helvella sphaerospora* Peck 1875

≡ *Gyromitra sphaerospora* (Peck) Sacc. 1889, ≡ *Helvellela sphaerospora* (Peck) Imai 1932, ≡ *Gyromitrodes sphaerospora* (Peck) Vassilkov 1942

= *Gyromitra gabretae* Kavina 1924, ≡ *Ochromitra gabretae* (Kavina) Velen. 1934, ≡ *Helvellela gabretae* (Kavina) Pouzar et Svrček 1954, ≡ *Helvellela sphaerospora* f. *gabretae* (Kavina) Skirgieľo 1957, ≡ *Pseudorhizina sphaerospora* f. *gabretae* (Kavina) Pouzar 1961

The species is treated here as a member of the genus *Pseudorhizina* in accordance with arguments by Harmaja (1973), who thoroughly discussed the limit between *Pseudorhizina* and *Gyromitra*, and works by Abbott and Currah (1997) and O'Donnell et al. (1997). However, the fungus is recently also treated as a *Gyromitra* species (e.g. Dissing 2000).

OCCURRENCE OF *P. SPHAEROSPORA* IN THE CZECH REPUBLIC

Pseudorhizina sphaerospora was found at three localities on the territory of the present-day Czech Republic. At each of them its occurrence is quite different in character. There is a historical locality where the species was observed only once a long time ago (Plešný = Plechý Mts.), a locality with continuous occurrence for more than 80 years (Boubínský prales virgin forest) and a new locality, where the fungus was found quite recently (Žofínský prales virgin forest). For details see below.

Plešný (= Mt. Plechý)

Geographic position: Czech Republic, south Bohemia, Prachatice district, Šumava Mts. (= Bohemian Forest, Böhmerwald), Šumava National Park, 15 km S of the town of Volary, coordinates of the top of Mt. Plechý: 48° 46' 16" N, 13° 51' 25" E.

Remarks: The occurrence of *P. sphaerospora* at this locality is documented only by a short remark in a Czech-written paper by Kavina (1926: 85): “later I obtained a dry specimen [of *Gyromitra gabretae* = *P. sphaerospora*] from Mr. Frič who collected it in the virgin forest zone at Plešný”. There is no extant voucher specimen, although Kavina mentions it and his personal collections of *P. sphaerospora* from Boubínský prales (Kavina 1924, 1926) are present in the PRM herbarium. Consequently, the exact date when A. Frič collected the specimen is not known. Similarly, the exact geographic position is unknown. The term “Plešný” used by Kavina (1926) means most probably the mountain currently named Plechý (1378 m above sea level) in the Šumava Mts. (mountain range on the border between the Czech Republic on one side and Austria and Germany on the other side). However, it would be desirable to know the exact location of the record by Frič, as natural habitats on Mt. Plechý vary considerably according to slope and altitude (from mixed montane forests composed of *Fagus*, *Picea* and *Abies* to various types of montane *Picea* forests, e.g. *Calamagrostis* spruce forests, *Athyrium* spruce forests and bog spruce forests, see Chytrý et al. 2001, Neuhäuslová 2001). The virgin forests on the slopes of Mt. Plechý are currently protected as zone 1 (= strictly protected) of the Šumava National Park. These forests have been protected as a nature reserve since as early as 1933.

In spite of recent investigations carried out by J. Holec (several visits in period 1996–2006), A. Lepšová (Svoboda and Lepšová 2004) and V. Pouska (2005), *P. sphaerospora* was not observed.

Boubínský prales virgin forest

Other names of this locality used in literature and on herbarium labels: “Kubany Urwald” (see e.g. Luschka 1993), “Lukenský prales”, “Pažení = Basumský hřbet”.

Geographic position: Czech Republic, south Bohemia, former Prachatice District, Šumava Mts. (= Bohemian Forest, Böhmerwald), Šumava Protected Landscape Area, 9 km NW of the town of Volary, Boubínský prales National Nature Reserve, coordinates of the centre of the reserve: 48° 58' 39" N, 13° 48' 41" E.

Brief characteristics: mixed montane forest composed of *Fagus sylvatica*, *Picea abies* and *Abies alba*, with admixed *Acer pseudoplatanus* and *Ulmus glabra*, phytosociologically a mosaic of herb-rich beech forests, acidophilous beech forests and montane *Calamagrostis* spruce forests (Albrecht et al. 2003, Chytrý et al. 2001), some trees 400–500 years in age, core area (46.67 ha) never cut, never managed by foresters, representing a remnant of the original natural vegetation, with a high number of decaying dead and fallen trunks, protected as a nature reserve since 1858, forests surrounding the core area also natural, total area of the reserve: 677 ha, altitude range of the reserve: 874–1362 m, core area (enclosed by palisades): 930–1100 m.

Mycological characteristics: see Kubička (1960, 1973), partial data are present in dozens of publications on taxonomy, biodiversity and ecology of fungi both in Czech and foreign literature.

Finds of *P. sphaerospora*: for details, see Tab. 1. The data clearly show that the species is well-established in the Boubínský prales virgin forest and has been so for more than 80 years. The finds come from various parts of the nature reserve and from wood of several tree species (*Picea abies*, *Abies alba*, *Fagus sylvatica*). The older finds originate from a lower altitude (950-980 m) – the vicinity of the Kaplické (Boubínské) jezírko small water reservoir (pers. comm. by Z. Pouzar). Recent records by J. Holec are described below.

Fructification: second half of May to end of July, exceptionally until the first decade of August (old and partly decayed fruitbodies only).

Habitat and substrate of recent records. All recent finds by J. Holec (Tab. 1) are from the same fallen (not felled) trunk of *Picea abies* lying at an altitude of 1130 m above Lukenská cesta forest road. They are situated west of the W border of the core (palisade-enclosed) area of the nature reserve (see also Holec 1998, 1999). The trunk is old, having a diameter of about 1 m. At this site, the forest is composed of *Fagus sylvatica*, *Picea abies* and *Abies alba* and has a completely natural character (untouched by man, trees of various age, plenty of dead wood in various stages of decay). Phytosociologically, it represents an acidophilous beech forest in the sense of the Habitat catalogue of the CR (Chytrý et al. 2001), more exactly the association *Calamagrostio villosae-Fagetum*. The occurrence of *P. sphaerospora* in the trunk is indicated by fructification documented in the years 1997, 1998 and 2005 (Tab. 1). In the years 1997 and 1998, the fungus produced fruitbodies at the base of the fallen trunk. In 2005, this part of the trunk was strongly decayed (soft, covered with mosses) and probably exhausted by the mycelium of *P. sphaerospora* (and other lignicolous fungi). The fungus was observed in the medium part of the trunk and also on decayed wood in soil under the trunk (Tab. 1).

Remarks. The first author did not see *P. sphaerospora* in other parts of the Boubínský prales nature reserve in the period 1996-2006. However, this does not mean that at present the species occurs only in one trunk of *Picea*. The locality is so large that the fungus can easily remain undetected at some microlocalities within the area, especially when taking into account that the research by J. Holec was not focused on search for *P. sphaerospora* and was not performed in the whole area of the nature reserve.

Žofínský prales virgin forest

Geographic position: Czech Republic, south Bohemia, former Český Krumlov District, Novohradské hory Mts., approx. 15 km SSW of the town of Nové Hradky, 4.5 km E of the village of Pohorská Ves, near the former village of Žofín, Žofínský prales National Nature Reserve, coordinates of the centre of the reserve: 48° 39' 56" N, 14° 42' 18" E.

Tab. 1. Records of *Pseudorhizina sphaerospora* in the Boubínský prales virgin forest (arranged chronologically).

voucher specimen	substrate	part	alt. (m)	day	month	year	leg.
PRM 647168	<i>Fagus sylvatica</i>	trunk	?	16	6	1924	K. Kavina
PRM 647169	<i>Fagus sylvatica</i>	decayed trunk	?	19	6	1924	K. Kavina
PRM 647170	<i>Fagus sylvatica</i>	decayed trunk	?	19	6	1924	K. Kavina
PRM 608041	<i>Abies alba</i>	strongly decayed fallen trunk	950	31	5	1953	J. Herink and J. Kubička
PRM 608040	<i>Abies alba</i>	strongly decayed fallen trunk	950	16	7	1953	K. Kříž
PRM 608045	? <i>Fagus sylvatica</i>	decayed fallen trunk	950	16	7	1954	K. Kříž
PRM 608044	<i>Picea abies</i>	decayed fallen trunk	950	30	7	1954	K. Kříž
PRM 684019	?	?	?	22	6	1955	J. Kubička and B. Kubičková
PRM 684018	?	?	?	22	6	1955	J. Kubička and B. Kubičková
PRM 608043	<i>Abies alba</i>	decayed fallen trunk	950	26	6	1955	J. Herink
PRM 608047	<i>Picea abies</i>	decayed trunk	960	26	6	1955	B. Kubičková, J. Kubička and J. Herink
PRM 608050	<i>Picea abies</i>	fallen trunk	960	21	6	1959	J. Herink
PRM 608049	<i>Picea abies</i>	decayed wood near base of <i>Picea</i>	950	19	6	1960	J. Herink
PRM 608046	<i>Picea abies</i>	dead trunk of young <i>Picea</i>	950	21	6	1959	J. Herink
PRM 608048	<i>Picea abies</i>	decayed fallen trunk of large <i>Picea</i>	950	21	6	1959	J. Herink
PRM 608052	<i>Picea abies</i>	decayed fallen trunk and roots of a stump (of the same trunk)	960	19	6	1960	J. Herink
PRM 608051	<i>Abies alba</i>	roots of dead trunk	980	19	6	1960	J. Herink
CB 2018	<i>Abies alba</i>	fallen trunk	?	27	5	1979	J. Kubička and J. Kubičková
CB 1862	<i>Picea abies</i>	decayed fallen trunk	?	7	6	1979	Z. Kluzák
CB 1863	<i>Abies alba</i>	in detritus under fallen trunk of <i>Abies alba</i>	?	27	6	1979	J. Kubička
PRM 879875	<i>Abies alba</i>	fallen trunk and wood of this trunk	?	26	6	1981	J. Kubička, J. and Z. Kubička
CB 4700	<i>Picea abies</i>	in cavity of a decayed stump	945	5	7	1986	Z. Turičík
BRNM	<i>Fagus sylvatica</i>	decayed fallen trunk	1000	27	5	1989	T. Papoušek
PRM 898212	<i>Picea abies</i>	decaying fallen trunk covered with mosses: at base	1130	5	8	1997	J. Holec
PRM 896999	the same	the same trunk (see above): 10 fruitbodies on 2 places	the same	10	7	1998	J. Holec
not documented	the same	the same trunk (see above): 2 young fruitbodies in the middle of the trunk	the same	17	5	2005	J. Holec

not documented	the same	the same trunk (see above): 4 fruitbodies on the trunk, 1 fruitbody from decayed wood in soil under the trunk	the same	21	5	2005	J. Holec
not documented	the same	the same trunk (see above): 4 old fruitbodies (see above)	the same	15	6	2005	J. Holec
no fruitbodies	the same	the same trunk (see above): no fruitbodies (probably too soon for fructification after a cold and snow-rich winter)	the same	9	5	2006	J. Holec

Brief characteristics: mixed montane forest composed of *Fagus sylvatica*, *Picea abies* and *Abies alba*, with admixed *Acer pseudoplatanus* and *Ulmus glabra*, phytosociologically a herb-rich beech forest (Albrecht et al. 2003, Chytrý et al. 2001), some trees 300-400 years in age, most stands never cut, representing remnants of the original natural vegetation, at some places with narrow cuttings made before its designation as a nature reserve (i.e. almost 200 years ago, later naturally reforested) or slightly disturbed by selective cutting, completely unmanaged since 1945, with high amount of decaying dead and fallen trunks, protected as a nature reserve since 1838, area: 97.72 ha, altitude 734-830 m.

Mycological characteristics: Svrček and Kubička (1964, 1971), Beran (1996, 2004, 2005).

Find of *P. sphaerospora*: MTB 7354a, 1 km SSE of the former village of Žofín, W margin of the nature reserve, alt. 740 m, mixed forest: stand of *Picea abies* and *Abies alba* with admixed *Fagus sylvatica* and undergrowth of seedlings of *F. sylvatica*, 2 fruitbodies on decaying fallen trunk of *Picea abies* lying approx. 0.5 m above the soil surface, grown by mosses, in the vicinity of a small stream, 4 June 2005 leg. and det. M. Beran (CB 14536).

Habitat of the find: *P. sphaerospora* was found at a transition of two habitats – a beech forest of the association *Calamagrostio villosae-Fagetum* and a bog spruce forest of the association *Equiseto-Piceetum*. The first habitat belongs to subacidophilous forests usually dominated by *Fagus* with admixed *Abies* and *Picea* and montane plant species (e.g. *Lycopodium annotinum*, *Calamagrostis villosa*, *Luzula sylvatica*). In ŽP, it is not a climatic climax but an extrazonal community influenced by hydromorphic soils (modal or cambic pseudogleys) in the vicinity of streams and spring areas (Lepší et al. 2005). The second habitat in ŽP occurs in flat terrain with spring areas and in alluvial plains along streams. The soil is gley or histic gley. The plant and moss layer is a combination of *Picea* forest species (e.g. *Luzula sylvatica*, *Soldanella montana*, *Calamagrostis villosa*, *Bazzania trilobata*) and oligo-mesotrophic hygrophilous or spring area species (e.g. *Caltha palustris* subsp. *laeta*, *Chaerophyllum hirsutum*, *Equisetum sylvaticum*, *Myosotis nemorosa*, *Viola palustris*).

Remarks: *P. sphaerospora* was not observed in ŽP before 2005, in spite of visits by M. Svrček and J. Kubička (Svrček and Kubička 1964, 1971) and intensive monitoring (see Material and Methods) of mycobiota in the years 1991–1995 and 2004–2005 by M. Beran and collaborators (Beran 2005). During the monitoring, special attention was paid to fallen old trunks hosting many rare fungi. As *P. sphaerospora* is a very striking species, it is unlikely that it would have been overlooked if it had been present in ŽP before 2005. Consequently, *P. sphaerospora* seems to be a new species for the mycobiota of ŽP. Ecologically, it occurs there in the same habitat as in BP (see above).

SUBSTRATE

In the Czech Republic, *P. sphaerospora* has been found on wood of *Picea abies* (most frequently), *Abies alba* and *Fagus sylvatica* (Tab. 1 and data in the chapter on ŽP). According to available data from other European countries (see References), the species is almost exclusively found on wood of *Picea abies*, rarely on *Pinus* (Benkert 2000). The situation in North America is quite different, as the species is mostly found there “on very rotten deciduous (or rarely coniferous) logs or woody debris, in deciduous or mixed forests” (Abbott and Currah 1997). In the area of the Central Angara river (Russia: Siberia, near Irkutsk), the species was also found on wood of deciduous and coniferous trees (Astapenko 1990: 5 tree species).

HABITATS IN THE CZECH REPUBLIC

All records of *P. sphaerospora* in the CR originate from virgin forests. In the case of Plešný (= Mt. Plechý), the habitat was briefly described as a “virgin forest zone” without any details on their composition or location. On the other hand, the finds from the Boubínský prales and Žofínský prales virgin forests are well documented. The two sites belong to best studied and most valuable mycological localities not only in the Czech Republic but also in Central Europe. They represent rare remnants of natural forest vegetation almost untouched by man. Boubínský prales is protected (i.e. unmanaged and left for causation of natural processes) since 1858 and Žofínský prales since as early as 1838. From this point of view, both localities represent the best-preserved montane virgin forests of the Czech Republic. The “virgin forest character” is conditioned by the following factors: vegetation continuity (never cut), natural tree species composition, multi-aged structure, presence of dead wood in various stages of decay, relatively large area, stable, cold and humid meso- and microclimate. The mycobiota

of both localities is rich in rare fungi preferring natural habitats (Holec and Beran 2006, e.g. *Phellinus pouzarii*: BP, ŽP; *Skeletocutis odora*: ŽP; *Omphalina cyanophylla*: ŽP; *Pseudoplectania melaena*: BP, ŽP; *Baeospora myriadophylla*: BP, ŽP; *Rigidoporus crocatus*: BP, ŽP; *Multiclavula mucida*: BP, ŽP). Some rare species occurring in BP and ŽP have a boreal-montane distribution (e.g. *Amylocystis lapponica*: BP; *Laurilia sulcata*: BP; *Phellinus ferrugineofuscus*: BP, ŽP; *Perenniporia subacida*: BP). For several species the Boubínský and Žofínský praes virgin forests represent the only locality within the CR (*Amylocystis lapponica*: BP, *Laurilia sulcata*: BP, *Omphalina cyanophylla*: ŽP, etc.)

The conditions described above, which are quite unique in the current Czech landscape (mostly composed of man-influenced or man-made habitats), seem to be suitable also for *Pseudorhizina sphaerospora*, as it has never been found elsewhere in the CR. However, this only counts for the situation in the CR (see the discussion below).

HABITATS IN EUROPE

In 7 European countries, *P. sphaerospora* is included in national Red Lists (see Tab. 2) as a more or less endangered species. It is very interesting that in Norway and Sweden the species is reported from man-made habitats like agricultural landscapes (Brandrud et al. 2006) and urban environments (Gärdenfors 2005). Dissing (2000) writes that in Nordic countries (Norway, Sweden, Finland) the species usually occurs in man-made habitats and Torkelsen (1985) describes such habitats as follows: “in places influenced by man like depots for timber, saw-mills and even close to refuse-heaps”. Huhtinen (2006: pers. comm.) informed us that in Finland both recent finds are from sawdust and pulp factory remains and that the species is known only from places where woody litter or sawdust was previously accumulated (Ruotsalainen and Huhtinen 2005). The older Finnish records (Huhtinen 1983) originate from area used for decades as a disposal site for waste from a paper factory, where the species grew on small pieces of both coniferous and deciduous wood. In Slovakia, the two microlocalities observed by Pouzar and Svrček (1954) in Dedošova dolina valley were represented by timber used by man to strengthen a slope under a path along a mountain stream. However, Dedošova dolina valley is situated in the Velká Fatra National Park and has a remarkably high percentage of near-natural forests. It is probable that the trunk hosting *P. sphaerospora* was transported from forests in the vicinity and already contained mycelium of the fungus.

In the Alps in Switzerland, *P. sphaerospora* was found near an old saw-mill close to a stream (Stappung 1985), at the margin of a forest clearing on woody debris of *Picea* (Rahm 1970: alt. 1120 m) and on the root of an old *Picea* trunk grow-

ing in grass at the margin of a *Picea* stand (Hotz 1961: alt. 1700 m). In Germany (Benkert 2000) the species was found in a young *Pinus* (*sylvestris*?) stand on sandy soil at the margin of a *Pinus* forest. The fungus was observed in the vicinity of an old *Pinus* stump. All these finds originate from man-made or man-influenced habitats.

In the Czech Republic *P. sphaerospora* occurs, on the contrary, exclusively in the best-preserved montane virgin forests of the country with forest stand continuity (never cut) and a stable meso- and microclimate. In Poland, the species is also known from a virgin forest – the famous Białowieża National Park (e.g. collection at K cited by Abbott and Currah 1997). However, Białowieża is a lowland forest (mean altitude 170 m).

How to explain such a discrepancy in habitat preference between the Nordic countries, Germany and Slovakia (plus some records from Switzerland) on the one hand and the Czech records and Polish find from Białowieża virgin forest on the other? It is evident that *P. sphaerospora* does not prefer natural forests (as could be concluded using data only from the CR and Poland). The species seems to prefer either dead wood with a stable and high water content or cold and humid climatic conditions. Such conditions are met either in Nordic countries having a cold and humid climate, in the Alps at altitudes of about 1100–1850 m (see records from Switzerland: Hotz 1961, Rahm 1970, Stappung 1985, Pralong and Brunelli 1996), in Central and Eastern European montane and lowland virgin forests having a stable and humid mesoclimate (ensured by forest stand continuity and its dense canopy) and in wood of conifers supplied by water from streams (case of Slovak records: Pouzar and Svrček 1954). However, this hypothesis is preliminary and should be carefully tested in the future.

WORLDWIDE DISTRIBUTION

In Europe, *P. sphaerospora* is known from Norway, Sweden, Finland, Germany, Poland, Czech Republic, Croatia (see references in Tab. 1), Switzerland (Hotz 1961, Rahm 1970, Stappung 1985, Pralong and Brunelli 1996), Lithuania (Irsenaite 2004) and probably also from Italy, if the fruitbodies photographed by Cetto (1987: no. 2088) originate from this country. It occurs also in North America (see e.g. Abbott and Currah 1997: USA and especially Canada, in boreal regions) and Asia (e.g. Benkert 2000: Georgia – Caucasus, Astapenko 1990: Russia – Siberia, Imai 1954: Japan).

Tab. 2. *Pseudorhizina sphaerospora* in European Red Lists.

country	category of threat	criteria and endangerment	habitats	Red List, Red Book
Norway	VU (vulnerable)	small population in decline	forests, agricultural landscape	Brandrud et al. (2006)
Sweden	DD (data deficient)	—	forests, urban environments; known from 5 Swedish administrative provinces	Gärdenfors (2005)
Finland	VU (vulnerable)	population very small or restricted, endangered by over-growing of meadows after cessation of grazing or hay cutting or by the building of towns, rural areas, roads, etc.	mesic heath forests, old-growth or younger ones with plenty of decaying wood	Rassi et al. (2001)
Germany	R (rare, latently threatened)	—	<i>Pinus</i> forest	Benkert et al. (1992)
Poland	V (vulnerable)	taxa believed likely to move into the Endangered category in the near future if the causal factors continue operating	—	Wojewoda and Ławrynowicz (2006)
Czech Republic	CR (critically endangered)	occurrence at 2 localities only	mixed montane forests (<i>Fagus</i> , <i>Picea</i> , <i>Abies</i>): virgin forests, never cut, with high amount of decaying wood	Holec and Beran (2006), Kotlaba (1995)
Slovakia	VU (vulnerable)	—	on timbers of <i>Picea</i> and <i>Abies</i> used for the fortification of a slope under a path along a montane stream bank; for details see Pouzar and Svrček (1954)	Lizoň (2001), Kotlaba (1995)
Croatia	protected by law	—	—	Croatian public notice

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REFERENCES

- ABBOTT S. P. and CURRAH R. S. (1997): The *Helvellaceae*: Systematic revision and occurrence in northern and northwestern North America. – *Mycotaxon* 62: 1–125.
- ANTONÍN V. and BIEBEROVÁ Z. (1995): Chráněné houby ČR [Fungi protected by law in the Czech Republic]. – 88 p. Praha. (in Czech)
- ALBRECHT J. et al. (2003): Českobudějovicko [Českobudějovicko region]. – In: Mackovčín P. and Sedláček M., eds., Chráněná území ČR, svazek VIII, p. 1–808, Brno. (in Czech)
- ASTAPENKO A. A. (1990): Consortive relations in wood–destroying fungi in the central Angara river area. – *Mikologiya i Fitopatologiya* 24(4): 289–298.
- BENKERT D. (2000): Die Helvellaceen von Brandenburg und Berlin: Erkennung, Ökologie, Verbreitung. – *Verh. Bot. Ver. Berlin Brandenburg* 133: 399–448.
- BENKERT D. et al. (1992): Rote Liste der gefährdeten Großpilze in Deutschland. – 132 p. Eching.
- BERAN M. (1996): Houby Českokrumlovská [Die Pilze des Bezirks Český Krumlov]. – 32 p., 10 p. suppl. Český Krumlov. (in Czech with German summary)
- BERAN M. (2004): Houby (Fungi). – In: Papáček M., ed., Biota Novohradských hor: modelové taxony, společenstva a biotopy [Biota des Gratzener Berglands: charakteristische Taxa, Zönosen und Biotope], p. 93–99, České Budějovice. (in Czech)
- BERAN M. (2005): Inventarizační průzkum NPR Žofínský prales a NPP Hojná Voda z oboru mykologie. Závěrečná zpráva shrnující poznatky získané za dva roky průzkumu. – Ms., 42 p. [inventory report, depon. in: AOPK ČR Praha].
- BERAN M. and TONDL F. (1997): Chráněné houby v jižních Čechách [Fungi protected by law in southern Bohemia]. – 32 p. České Budějovice. (in Czech with English summary)
- BRANDRUD T. E., BENDIKSEN E., HOFTON T. H., HØILAND K. and JORDAL J. B. (2006): Sopp. Fungi. – In: Norsk Rødliste 2006. 2006 Norwegian Red List, p. 103–128, Trondheim.
- CHYTRÝ M., KUČERA T. and KOČÍ M., eds. (2001): Katalog biotopů České republiky [Habitat catalogue of the Czech Republic]. – 304 p. Praha. (in Czech with English summary)
- DISSING H. (2000): *Gyromitra* Fr. – In: Hansen L. and Knudsen H. (eds.), Nordic macromycetes, Vol. 1, Ascomycetes, p. 165–177, Helsinki.
- GÄRDENFORS U., ed. (2005): Rödlistade arter i Sverige 2005 [The 2005 redlist of Swedish species]. – 496 p. Uppsala.
- HARMAJA H. (1973): Amendments of the limits of the genera *Gyromitra* and *Pseudorhizina*, with the description of a new species, *Gyromitra montana*. – *Karstenia* 13: 48–58.
- HERINK J. (1955): Ucháčovec šumavský – *Helvellula gabretae* (Kavina) Pouz. et Svrček v Československu [*Helvellula gabretae* (Kavina) Pouz. et Svrček in Czechoslovakia]. – *Čes. Mykol.* 9: 151–156. (in Czech with Russian and English summaries).
- HOLEC J. (1998): Zákonem chráněné nebo v Červené knize zahrnuté druhy hub na Šumavě – shrnutí literárních údajů a současný stav výskytu [Šumava's fungi protected by law or included in the Red Book: a review of literature and current distribution]. – *Silva Gabreta* 2: 35–52. (in Czech with English abstract).
- HOLEC J. (1999): Houby Šumavy chráněné zákonem nebo zahrnuté v Červené knize: nálezy v roce 1998 [Bohemian Forest fungi protected by law or included in the Red Book: finds in the year 1998]. – *Silva Gabreta* 3: 17–24. (in Czech with English abstract)
- HOLEC J. (2003): Houby [Fungi]. – In: Team of authors, Šumava. Příroda. Historie. Život, p. 205–212, Praha. (in Czech)
- HOLEC J. and BERAN M., eds. (2006): Červený seznam hub (makromycetů) České republiky [Red list of fungi (macromycetes) of the Czech Republic]. – *Příroda* 24: 1–282. (in Czech with English summary)
- HUHTINEN S. (1983): Finnish records of discomycetes: *Pseudorhizina sphaerospora* and *Poculum sydowianum*. – *Karstenia* 23: 10–12.

- IMAI S. (1954): *Elvellaceae Japoniae*. – Science Report Yokohama Nat. Univ. 2: 1–35.
- IRSENAITE R. (2004): Diversity and conservation of macromycetes in Dusetos forest, Sartai Regional Park. – *Botanica Lithuanica* 10(3): 177–194.
- KAVINA K. (1924): Sur une Gyromitre nouvelle. – *Acta Botanica Bohemica* 3: 16–20.
- KAVINA K. (1926): Fragmenta mycologica. – *Věda Přírodní* 7: 82–87. (in Czech)
- KLUZÁK Z., SMOTLACHA M., ERHART J. and ERHARTOVÁ M. (1985): Poznáváme houby. – 374 p. Praha.
- KOTLABA F. et al. (1995): Červená kniha ohrožených a vzácných druhů rostlin a živočichův SR a ČR. Vol. 4. Sinice a riasy. Huby. Lišajníky. Machorasty [Red book of threatened and rare species of the Slovak and Czech Republics]. – 221 p. Bratislava. (in Czech with English and German summaries)
- KUBIČKA J. (1960): Die höheren Pilze des Kubani-Urwaldes im Böhmerwald. – *Čes. Mykol.* 14: 86–90.
- KUBIČKA J. (1973): Přehled dosud publikovaných druhů hub z Boubínské pralesy na Šumavě [Übersicht den bisher veröffentlichten Pilzarten aus dem Kubani Urwald (Boubín) im Böhmerwald]. – *Čes. Mykol.* 27: 212–228. (in Czech and Latin with German abstract)
- LEPŠÍ M., LEPŠÍ P. and BOUBLÍK K. (2005): Inventarizační průzkum NPR Žofínský prales z oboru botanika. – Ms., 22 p. [inventory report, depon. in: AOPK ČR Praha, Středisko AOPK ČR České Budějovice].
- LIZOŇ P. (2001): Červený zoznam húb Slovenska. 3. verzia (december 2001) [Red list of Slovak fungi. 3rd version (December 2001)]. – In: Baláž D., Marhold K. and Urban P., eds., Červený zoznam rastlín a živočichův Slovenska, Ochr. Prír. 20, Suppl., p. 6–13.
- LUSCHKA N. (1993): Die Pilze des Nationalparks Bayerischer Wald. – *Hoppea* 53: 5–363.
- NEUHÄUSLOVÁ Z., ed. (2001): Mapa potenciální přirozené vegetace Národního parku Šumava. The map of potential natural vegetation of the Šumava National Park. Karte der potentiellen natürlichen Vegetation des Šumava Nationalparks. – *Silva Gabreta*, Suppl. 1: 1–189, 1 map.
- O'DONNELL K. O., CIGELNIK E., WEBER N. S. and TRAPPE J. M. (1997): Phylogenetic relationships among ascomycetous truffles and the true and false morels inferred from 18S and 28S ribosomal DNA sequence analysis. – *Mycologia* 89: 48–65.
- PAPOUŠEK T., ed. (2004): Velký fotoatlas hub z jižních Čech [Large atlas of mushroom photographs from southern Bohemia]. – 820 p. České Budějovice. (in Czech with German, French and English summary)
- POUSKA V. (2005): Tlející dřevo smrku a výskyt hub na Trojmezské hoře na Šumavě [Decaying wood of spruce and the occurrence of fungi at Trojmezská Mountain in Bohemian Forest]. – 40 p., 10 p. suppl., České Budějovice [thesis, Faculty of Biological Sciences, University of South Bohemia, Czech Republic]. (in Czech)
- POUZAR Z. (1961): Systematická hodnota ucháčovce šumavského – *Helvellella gabretae* (Kavina) Pouz. et Svr. [The taxonomical value of *Helvellella gabretae* (Kavina) Pouz. et Svr.]. – *Čes. Mykol.* 15: 42–45. (in Czech and English)
- POUZAR Z. and SVRČEK M. (1954): Ucháčovec šumavský – *Helvellella gabretae* (Kavina) Pouz. et Svr. na Slovensku [*Helvellella gabretae* in Slovakia]. – *Čes. Mykol.* 8: 170–172. (in Czech)
- PRALONG C. and BRUNELLI F. (1996): *Pseudorhizina sphaerospora* (Peck) Pouz., un splendide ascomycete peu fréquent. – *Bulletin Valaisan de Mycologie* 22: 32–33, colour photograph no. 1.
- RAHM E. (1970): Über einige *Rhiziniaceae* aus dem Hochtal von Arosa. – *Schw. Z. Pilzk.* 48(7): 77–87.
- RASSI P., ALANEN A., KANERVA T. and MANNERKOSKI I., eds. (2001). The red list of Finnish species. – 432 p. Helsinki. <http://www.ymparisto.fi/default.asp?node=8366&lan=en>
- RUOTSALAINEN J. and HUHTINEN S. (2005): Tunnetko monenlaiset korvasienemme? [Are you aware of our different Gyromitras?]. – *Sieni Lehti* 57(1): 6–13. [in Finnish with English summary]
- STAPPUNG L. (1985): *Pseudorhizina sphaerospora* (Peck) Pouz. – *Schw. Z. Pilzk.* 63(7): 134–136.
- SVOBODA M. and LEPŠOVÁ A. (2004): Kvantitativní charakteristiky tlejícího dřeva a význam hub při jeho rozkladu ve smrkovém horském lese v oblasti Trojmezská, NP Šumava [Quantitative characteristics of decaying wood and importance of fungi in process of decomposition in mountain spruce forest, Trojmezská region, Šumava NP]. – In: Dvořák L. and Šustr P. (eds.), Aktuality šumavského výzkumu II, Proceedings of the conference 4.–7. Oct. 2004, p. 280–287, Srní.

- SVRČEK M. and KUBIČKA J. (1964): Houby Žofínského pralesa v Novohradských horách [Fungi from the Žofínský virgin forest in the Novohradské Mountains (Southern Bohemia)]. – Čes. Mykol. 18: 157–179. (in Czech with English summary)
- SVRČEK M. and KUBIČKA J. (1971): Druhý příspěvek k poznání mykoflory Žofínského pralesa v Novohradských horách [Zweiter Beitrag zur Kenntnis der Mykoflora des Urwaldes “Žofínský prales” im Gebirge Novohradské hory (Südböhmen)]. – Čes. Mykol. 25: 103–111. (in Czech and Latin with German summary)
- TORKELSEN A.–E. (1985): *Pseudorhizina sphaerospora* – a rare, beautiful fungus of early summer. – *Agarica* 6(12): 358–362.
- VELENOVSKÝ J. (1934): *Monographia discomycetum bohemiae. Pars I, Pars II.* – 436 p., 31 tab. Praha.
- WOJEWODA W. and ŁAWRYNOWICZ M. (2006): Red list of the macrofungi in Poland [Czerwona lista grzybów wielkoowocnikowych w Polsce]. – In: Mirek Z., Zarzycki K., Wojewoda W. and Szelağ Z. (eds), *Red list of plants and fungi in Poland [Czerwona lista roślin i grzybów Polski]*, p. 53–70, Kraków.