Silva Gabreta	vol. 14 (2)	p. 85–92	Vimperk, 2008

Rare fungus *Pseudorhizina sphaerospora* in the Boubínský Prales virgin forest (Czech Republic, Bohemian Forest) – its microlocalities and habitats in the year 2007

Jan Holec[1,*] & Tomáš Kučera[2]

[1]National Museum, Mycological Department, Václavské nám. 68, CZ-11579 Praha 1, Czech Republic
[2]Institute of Systems Biology and Ecology, Academy of Sciences of the Czech Republic, Na Sádkách 7, CZ-37005 České Budějovice, Czech Republic
**jan_holec@nm.cz*

Abstract
In 2007, rare, critically endangered and protected fungus *Pseudorhizina sphaerospora* (Ascomycota, Pezizales, Discinaceae) was found at 5 new microlocalities in the Boubínský Prales virgin forest, the species-richest locality in the Czech Republic. The sites were analysed by means of phytosociological relevés. The fungus produced fruitbodies on old fallen trunks of *Picea* and *Abies* occurring in permanently moist to waterlogged sites. The finds originate from principally the same vegetation unit (association *Dentario enneaphylli-Fagetum*, mostly from its subassociation *impatientetosum*). Frequency of fruitbodies is very low (just on several fallen trunks from the hundreds of trunks screened) and their occurrence at suitable microlocalities is probably random. *P. sphaerospora* was found both in sites having character of a virgin forest and in sites slightly influenced by man (but still in natural forest stands).

Key words: Ascomycota, ecology, phytocoenology, dead wood

Introduction

Distribution and ecology of a rare fungus *Pseudorhizina sphaerospora* (Ascomycota, Pezizales, Discinaceae) in the Czech Republic with respect to other European countries was recently evaluated by Holec & Beran (2007). The conclusions were based on records carried out up to the year 2006 inclusive and on older published data. It was shown that in the Czech Republic the species clearly prefers montane virgin forests representing rare remnants of natural vegetation almost untouched by man. At present, the species is known only from the Boubínský Prales and Žofínský Prales virgin forests which are the best preserved forest reserves of the Czech Republic. On the contrary, in Nordic countries, Switzerland, Germany, and Slovakia, the species is known mostly from man-made or man-influenced habitats (see summarised data in Holec & Beran 2007).

In 2007, *P. sphaerospora* was found at 5 new microlocalities within the Boubínský Prales virgin forest, the richest locality of the species in the Czech Republic. The sites were thoroughly analysed by means of phytosociological relevés. It enabled to evaluate the habitat preference of *P. sphaerospora* at this locality more precisely than in the past, which is the main aim of this paper.

Material and methods

The detailed occurrence of *Pseudorhizina sphaerospora* in the Boubínský Prales virgin forest was studied during 2 visits: 13 June 2007 and 19 June 2007. The search was done by J. Holec, T. Kučera (for their addresses see above), and D. Půbal (Šumava Protected Landscape Area Administration). It was systematically devoted only to *P. sphaerospora* and performed in the core area (46.67 ha, enclosed by palisades; for characteristics see Albrecht 2003, Holec & Beran 2007) of the Boubínský Prales National Nature Reserve and along the trail around the core area. During the search, hundreds of fallen trunks were screened for the presence or absence of *P. sphaerospora*. One older microlocality (no. 3, records from period 1997–2005, published by Holec 1998, 1999; Holec & Beran 2007) was added to the set of microlocalities studied phytosociologically (exact position of older records by Kavina, Kříž, Herink, Kubička, Papoušek, Turičík etc. – for their review see Holec & Beran 2007 – is not known by the present authors).

The phytosociological relevés were made according to the Braun-Blanquet phytosociological approach with the cover being estimated by using the extended Braun-Blanquet scale: r (rare), + (≤1% cover), 1 (2–4%), 2m (5%), 2a (6–15%), 2b (16–25%), 3 (26–50%), 4 (51–75%), 5 (76–100%). Nomenclature of vascular plants follows Kubát et al. (2002).

Voucher specimens are deposited in herbarium PRM (National Museum, Praha).

Brief characteristics of the Boubínský Prales virgin forest

For detailed description, see Albrecht et al. (2003). Other names of this locality used in literature and on herbarium labels: "Kubany Urwald", "Lukenský prales", "Pažení = Basumský hřbet". Geographic position: Czech Republic, South Bohemia, former Prachatice District, Bohemian Forest (=Šumava Mts., 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.

Habitats, naturalness, protection: 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 2003, Chytrý et al. 2001), some trees 400–500 years old, core area (46.67 ha) a virgin forest, never clear-cutted, 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, most 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 e.g. Kubička (1960, 1973), Holec & Beran (2007); partial data are present in dozens of publications on taxonomy, biodiversity and ecology of fungi both in Czech and foreign literature.

For purposes of this article (and with accordance in common use), the German side of the Bohemian Forest is named Bayerischer Wald and the Czech side of the same mountain range is named Šumava.

Abbreviations: BPVF: Boubínský Prales virgin forest, CR: Czech Republic, DP: David Půbal, JH: Jan Holec, TK: Tomáš Kučera.

Results and Discussion

Microlocalities in the Boubínský Prales virgin forest in 2007

For detailed information see Table 1. The microlocalities can be divided into three groups.

1. Only two microlocalities (numbers 5 and 6) were located within the core area of the BPVF in spite of careful search of 3 visitors (JH, TK, DP) in the whole core area. These records originate from the virgin forest (for detailed habitat evaluation see below).

2. Surprisingly, three microlocalities (no. 1, 2, 4) were situated close to forest path (= educational route) along the palisade enclosing the core area. Although the sites are surrounded by virgin forest at least from one side (the core area), the sites themselves are slightly influenced by man (cutting of trunks along the path and resulting vegetation and microclimatic changes, solidification of the soil for the path etc.).

3. One microlocality (no. 3) is situated in virgin forest outside the core area (about 100 m W of it). In 2007, fruitbodies of *P. sphaerospora* were not found there, but they were observed there in the years 1997–2005 (Holec & Beran 2007).

It is surprising that no fruitbodies of *P. sphaerospora* were found on fallen *Picea* trunks in bog *Picea* forests close to Boubínské (=Kaplické) Jezírko water reservoir and along the Kaplický Potok stream. In the past, this part of the core area was the main microlocality of *P. sphaerospora* in the BPVF (pers. comm. of Z. Pouzar based on his field experience and discussions with J. Herink, author of detailed paper on *P. sphaerospora*, see Herink 1955).

Vegetation and habitat ecology at microlocalities

All microlocalities with the occurrence of *P. sphaerospora* (Table 1) were sampled by phytosociological relevés for the vegetation description and habitat analysis (Table 2). According to the Czech vegetation survey (Moravec & Husová 2000), the plant community belongs to the alliance *Fagion* Luquet 1926, in-between position of the suballiances *Eu-Fagenion* Oberdorfer 1957 em. Tüxen in Oberdorfer & Tüxen 1958 and *Acerenion* Oberdorfer 1957 em. Husová in Moravec et al. 1982. This intermediate position relates to habitat micromosaics in the core area of the BPVF which is caused by exposition (northeast to southeast slopes) and soil wetness (many slope springs and brooklets). Species-rich herb layer of the association *Dentario enneaphylli-Fagetum* Oberdorfer ex W. & A. Matuszkiewicz 1960 is present on drier sites. The wet sites are dominated by *Petasites albus*, *Stellaria nemorum*, *Athyrium filix-femina*, and *Impatiens noli-tangere*. This plant community belongs to the subassociation *Dentario enneaphylli-Fagetum impatientetosum* (Hartmann & Jahn 1967) Moravec 1974. It falls under Natura 2000 habitat 9130 *Asperulo-Fagetum* beech forests (Chytrý et al. 2001). The unit of herb-rich beech forest is the prevailing one in the surrounding area of the Šumava National Park in the map of the potential natural vegetation (Neuhäuslová 2001).

Data published in the previous paragraph correct a misleading information published by the first author in his previous publication on *P. sphaerospora* (Holec & Beran 2007), where its habitat in the BPVF (microlocality 3) was erroneously classified as *Calamagrostio villosae-Fagetum*. It was caused by no data analysis of this vegetation type at this microlocality.

In the central European context of classification of broadleaved mountain forests (Hartmann & Jahn 1967), such stands were considered the mountain beech-sycamore forest, association *Aceri-Fagetum* Bartsch 1940. Such a vegetation is typically described from hercynic-sudetic mountains [e.g. Vosges, Schwarzwald, Rhön, Harz, Jizerské Hory, Giant Mts. (=Krkonoše), Góry Stolowe, Śnieżnik Klodzki, Králický Sněžník, Hrubý Jeseník, Bohemi-

Table 1. Basic data on 5 microlocalities of *Pseudorhizina sphaerospora* in the Boubínský Prales virgin forest found in 2007 and 1 microlocality (no. 3) known by the first author from past investigations (see Holec 1998, 1999, Holec & Beran 2007). * – not found in 2007. The numbers of microlocalities agree with numbers of phytocoenological relevés in Table 2.

rel. no.	coordinates	altitude (m a.s.l.)	site	habitat (for details see Table 2)	host tree	tree part	stage of decay	date	found by	voucher specimen
1	48°58'22.4"N, 13°49'00.32"E	960	S of core area, between palisade enclosing it and educational route around the core area	small spring area within mixed montane forest	*Picea abies*	fallen trunk (diam. 0.7 m), sawed at both ends, lying in water	soft wood, covered with mosses	13 June 2007	J. Holec	PRM (JH28/2007)
2	48°58'34"N, 13°48'40"E	1050	E of core area, between palisade enclosing it and Lukenská cesta forest road	natural forest (mixed montane forest)	*Abies alba*	fallen trunk (diam. 1 m), about 3 m up the trunk base	naked soft wood (without bark), covered with mosses	13 June 2007	J. Holec	not documented
3	48°58'33"N, 13°48'28"E	1130	E of core area, slope above Lukenská cesta forest road	virgin forest (mixed montane forest), slightly influenced by selective cutting of some trees	*Picea abies*	fallen trunk (diam. 1 m)	soft wood covered with mosses, wood debris on soil	13 June 2007*	not found	
4	48°58'38"N, 13°48'33"E	1080	E of core area, between palisade enclosing it and Lukenská cesta forest road	man-influenced open site within natural mixed montane forest	*Picea abies*	fallen trunk (diam. 1 m)	hard wood covered with bark	13 June 2007	J. Holec	not documented
5	48°58'40" N, 13°48'77" E	1020	core area: S part	near small stream within mixed virgin forest (*Picea*, *Fagus*) with multi-aged tree structure	*Picea abies*	roots at stem base	hard wood without bark and slightly soft wood without bark	19 June 2007	D. Půbal	not documented
6	48°58'40"N, 13°48'78" E	1030	core area: S part	virgin forest (*Fagus*, *Picea*) with multi-aged tree structure 10 m of a small stream	*Picea abies*	completely decayed trunk (diam. 0.7 m) losing its original shape	completely decayed soft wood	19 June 2007	J. Holec	not documented

an Forest]. The most similar stands to the vegetation of the BPVF are reported from the Bayerischer Wald (Hartmann & Jahn 1967: Table 5), e.g. from Zwieseler Waldhaus (850 m a.s.l.), Ruselhänge (820 m a.s.l.), and Wolfsriegel (950 m a.s.l.) (for the vegetation comparison see Table 2). The absence of tall-forb mountain species in sycamore-beech forest in the Šumava Mts. (Czech side of the Bohemian Forest) is conspicuous just in larger context of Central European synthesis (Hartmann & Jahn 1967, Table III). The diagnostic species of *Aceri-Fagetum* like *Aconitum napellus* agg., *Adenostyles alliariae*, *Athyrium distentifolium*, *Ranunculus aconitifolius*, *Rumex arifolius*, *Streptopus amplexifolius*, and *Thalictrum aquilegiifolium* lack in herb layer of this forest type in the Šumava Mts. All these species except for *Adenostyles alliariae* are present in other habitats of the Šumava Mts. but we did not register them in our vegetation samples. *Athyrium distentifolium* and *Aconitum plicatum* (Šuk in Kolektiv 1995–2007, unconfirmed finding) are reported from the Boubín Mt., *Ranunculus aconitifolius* occurs in this area along brooks, *Rumex arifolius* and *Thalictrum aquilegiifolium* are relatively common in open non-forest enclaves outside the Boubín massif, and *Streptopus amplexifolius* is well known from the mountain spruce forests of the Plechý–Trojmezná–Třístoličník mountain massif. Although most of the diagnostic species of *Aceri-Fagetum* occur directly in the Boubín Mt. or in its vicinity, they do not grow in the herb layer in sampled stands.

In the Bohemian Forest context, the BPVF is situated in very large forest complex generally consisting of montane spruce forests in the highest position and cultural spruce forests in lower position (altogether dozens of square kilometres). Inside the BPVF, the core area (46 ha) represents the most valuable virgin fir-spruce-beech forest of the Šumava Mts. It is the original unmanaged natural forest which was declared to nature reserve already in 1858. We suppose that just the history without disturbance, age heterogenity of its tree layer and rich presence of fallen trunks in various stages of decay are the most important factors enabling the occurrence of the rarest species of fungi (for their survey see e.g. Kubička 1973, Holec & Beran 2007).

From the microhabitat point of view, the most important ecological factor present at all microlocalities of *P. sphaerospora* is the high soil moisture. The fungus typically occurs in spring areas and in sites with slowly flowing surface water under the host trunk. Therefore the microhabitat and subsequently the substrate are wet over the whole vegetation season. At the first microlocality near the pathway (no. 1; see Tables 1, 2) the species grows on the trunk laying directly in the forest spring, ass. *Cardamino-Chrysosplenietum alternifolii* Maas 1959 (class *Montio-Cardaminetea* Br.-Bl. & Tüxen ex Klika & Hadač 1944). The next microlocality near the pathway (no. 4) is an open enclave in local depression, without the tree and shrub layers, near small brook underflowing the crossroad. The two other localities (no. 5, 6) were inside the core area of the BPVF, always near a brook or a spring depression. For details see Table 1.

Conclusions

The data presented and discussed above show that *Pseudorhizina sphaerospora* produces fruitbodies on dead wood (mostly old fallen trunks) of *Picea* and *Abies* occurring in permanently moist to waterlogged sites both in the core area of the BPVF and in its close surroundings. The finds originate from principally the same vegetation unit, concretely from the association *Dentario enneaphylli-Fagetum*, mostly from its subassociation *impatientetosum*. In the central Europe context, the vegetation at *Pseudorhizina* microlocalities can also be classified as mountain beech-sycamore forest (association *Aceri-Fagetum*), but lacking some of its diagnostic species (tall-forb plants). The frequency of fruitbodies of *P. sphaerospora*

is very low (just on several fallen trunks from the hundreds of trunks inspected) and their occurrence at suitable microlocalities is probably random (in spatio-temporal pattern of fallen trunks). *P. sphaerospora* was found both in sites having strictly virgin forest character (core area: microlocalities 5, 6; above core area: 3) and in sites slightly influenced by man (microlocalities 1, 2, 4; close to forest path = educational route around the core area), but still having character of a natural forest.

Table 2. Phytocoenological relevés of *Pseudorhizina sphaerospora* microlocalities and comparison with *Aceri-Fagetum* in Bayerischer Wald (German side of the Bohemian Forest) (column H&J: Hartmann & Jahn 1967: Table 5, values I–III explain presence in 1–3 samples). Plant species are arranged according to their frequency in all 6 microlocalities and their cover. The numbers of relevés agree with numbers of microlocalities in Table 1.

Relevé No.	1	2	3	4	5	6	H&J
Altitude (m a.s.l.)	960	1050	1130	1080	1020	1030	
Exposition (orientation)	NEE	NEE	NNE	NE	SEE	SEE	
Inclination (degrees)	10	15	15	20	15	10	
Area (m^2)	10	150	225	75	150	150	
E_3 (%)	0	70	70	5	40	50	
Picea abies		3	3	1	2b	2a	III
Fagus sylvatica		3	2b	1	2b	3	III
E_2 (%)	0	15	15	5	30	30	
Fagus sylvatica		2a	2a	2m	3	3	II
Picea abies					+	+	
Sambucus racemosa		+		+			I
Acer pseudoplatanus		r		+			II
E_1 (%)	70	70	40	95	20	15	
Stellaria nemorum	2m	3	1	3	+	+	I
Petasites albus	2b	+	2a	2a	+	+	III
Athyrium filix-femina	2a	+	+	2b	+	+	III
Oxalis acetosella	1	+	1	1	+	1	II
Dryopteris dilatata		2m	2m	+	1	1	II
Impatiens noli-tangere	3		+	+	+	+	III
Galeobdolon montanum	+	2a	2m	+		2m	III
Senecio ovatus	r		2m	1		+	III
Gymnocarpium dryopteris		+	2m		1	+	I
Ranunculus repens	2m	+			+		
Myosotis nemorosa	2m				+	(+)	I
Carex sylvatica	+	+			+		
Circaea alpina	r		+		r	(+)	I
Rubus idaeus		+		2a		+	II
Picea abies juv.		+	+		+		
Prenanthes purpurea		+		+		+	II
Calamagrostis arundinacea		+	+		+		I
Ajuga reptans			+		(+)	+	III
Ranunculus lanuginosus				+			I
Cicerbita alpina				+		+	
Vaccinium myrtillus					2m	+	

Table 2. Continued.

Relevé No.	1	2	3	4	5	6	H&J
Chaerophyllum hirsutum	+				+		I
Soldanella montana					+	+	
Fagus sylvatica juv.					+	+	
Chrysosplenium alternifolium	+						I
Cardamine impatiens	r						
Lysimachia nemorum	+						II
Veronica montana	+						I
Viola palustris	r						
Sorbus aucuparia juv.			+				I
Festuca gigantea			r				
Phegopteris connectilis			+				
Hieracium murorum			+				
Equisetum sylvaticum					+		
Abies alba juv.					+		
Lysimachia vulgaris					+		
Valeriana dioica					+		
Luzula sylvatica					+		I
Carex remota					(+)		I

Other species (H&J): *Abies alba* (E_3) III, *Actaea spicata* III, *Dryopteris filix-mas* II, *Festuca altissima* II, *Fragaria vesca* I, *Galium odoratum* II, *Geranium robertianum* II, *Lonicera nigra* I, *Maianthemum bifolium* I, *Paris quadrifolia* II, *Pulmonaris officinalis* I, *Sanicula europaea* III, *Urtica dioica* I, *Veronica officinalis* I, *Viola reichenbachiana* II.

Acknowledgements. We thank D. Půbal (Šumava Protected Landscape Area Administration) for his help during the field search for *Pseudorhizina sphaerospora* and M. Štech for consultation of the distribution of some diagnostic species in the Šumava Mts. Three anonymous reviewers made valuable comments. J. Holec was financially supported by the Ministry of Culture of the Czech Republic (MK00002327201), T. Kučera by institutional research plan AV0Z60870520.

References

Albrecht J. (ed.), 2003: Českobudějovicko. In: *Chráněná území ČR (svazek VIII)*. [*Protected areas of the Czech Republic, VIII. České Budějovice Region*], Mackovčin P., Sedláček M. (eds) Agentura ochrany přírody a krajiny ČR a Ekocentrum Brno, Praha, 808 pp. (in Czech).

Chytrý M., Kučera T. & Kočí M. (eds), 2001: *Katalog biotopů České republiky* [*Habitat catalogue of the Czech Republic*]. Agentura ochrany přírody a krajiny ČR Praha, 304 pp. (in Czech with English summary).

Hartmann F.K. & Jahn G., 1967: *Waldgesellschaften des mitteleuropäischen Gebirgsraumes nördlich der Alpen*. Gustav Fischer Verlag Jena, 635 pp.

Herink J., 1955: Ucháčovec šumavský – *Helvellela gabretae* (Kavina) Pouz. et Svrček v Československu [*Helvellela gabretae* (Kavina) Pouz. et Svrček in Czechoslovakia]. *Česká Mykologie*, 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. & Beran M., 2007: Distribution, ecology and fructification of a rare ascomycete, *Pseudorhizina sphaerospora*, in the Czech Republic and its habitats in Europe. *Czech Mycology*, 59: 51–66.

Kolektiv, 1995–2007: Floristická databáze ke květeně Šumavy. Ms., depon. in PřF JU, České Budějovice (access M. Štech).

Kubát K., Hrouda L., Chrtek J. jun., Kaplan Z., Kirschner J. & Štěpánek J. (eds), 2002: *Klíč ke květeně České republiky* [*Key to the flora of the Czech Republic*]. Academia Praha, 927 pp. (in Czech).
Kubička J., 1960: Die höheren Pilze des Kubani-Urwaldes im Böhmerwald. *Česká Mykologie*, 14: 86–90.
Kubička J., 1973: Přehled dosud publikovaných druhů hub z Boubínského pralesa na Šumavě [Übersicht den bisher veröffentlichten Pilzarten aus dem Kubani Urwald (Boubín) im Böhmerwald]. *Česká Mykologie*, 27: 212–228 (in Czech and Latin with German abstract).
Moravec J. & HusovÁ J., 2000: Fagion. In: *Hygrophilous, mesophilous and xerophilous deciduous forests. Vegetation survey of the Czech Republic*, Vol. 2, Moravec J. (ed) Academia, Praha, pp. 141–183.
Neuhäuslová Z. (ed.), 2001: The map of potential natural vegetation of the Šumava National park, Explanatory text. *Silva Gabreta*, Supplementum 1: 75–129.

Received: 25 April 2008
Accepted: 30 June 2008