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The wood-rotting bluing *Psilocybe* species in Central Europe – an identification key

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An identification key to psychoactive bluing *Psilocybe* species growing on woody debris in Central Europe is presented. It is mainly based on microcharacters and includes 7 taxa (6 species and 1 variety) of the stirpes *Serbica* and *Cyanescens* (former "*Psilocybe cyanescens* complex"). Micro-, macroscopical, ecological and phenological characters and distribution of the taxa in Europe are presented and discussed.

Key words: *Strophariaceae*, taxonomy, identification guide, hallucinogenic fungi, psilocybin mushrooms.

Borovička J. (2008): Klíč k určování středoevropských na dřevě rostoucích modrajících lysohlávek. – Czech Mycol. 60(2): 173–192.

Klíč k určování středoevropských modrajících lysohlávek, které rostou na zbytcích dřeva, založený zejména na mikroskopických znacích. Zahrnuje 7 taxonů (6 druhů a 1 varietu) ze skupiny *Serbica* a *Cyanescens* (tzv. komplexu lysohlávky modrající – *Psilocybe cyanescens*). Jsou diskutovány jejich mikroskopické a makroskopické znaky včetně ekologických aspektů a rozšíření v Evropě.

INTRODUCTION

During the 1980s, the European bluing *Psilocybe* species were studied by the German mycologist G. J. Krieglsteiner, who included *P. serbica* M. M. Moser et E. Horak, *P. mairei* Singer and *P. bohemica* Šebek ex Šebek as synonyms of *P. cyanescens* Wakef. 1946 emend. Krieglst. (Krieglsteiner 1984, 1986). This concept has been widely accepted in Europe (e. g., Ludwig 2001, Bon and Roux 2003, Horak 2005, Knudsen and Vesterholt 2008). On the other hand, Guzmán (1995) recognises *P. cyanescens*, *P. serbica* and *P. bohemica* as good species, and Noordeloos (1999) pointed out that this group of taxa is in need of critical revision.

Bluing *Psilocybe* species are very rare in Western Europe but quite common in certain areas of the Czech Republic. Since 1999, I have studied many fresh collec-

tions containing thousands of fruitbodies and many herbarium specimens of these *Psilocybe* species. Three new taxa – *P. arcana* Borovička et Hlaváček, *P. moravica* Borovička, and *P. moravica* var. *sternberkiana* Borovička were recently described from the Czech Republic (Borovička and Hlaváček 2001a; Borovička 2003, 2006). The results of my studies of macroscopic and microscopic characters indicate that Krieglsteiner's broad concept of *P. cyanescens* Wakef. cannot be accepted (Borovička 2005).

This is an identification key to bluing *Psilocybe* species of the section *Semilanceatae* Guzmán (1995) belonging to stirpes *Serbica* and *Cyanescens* (Borovička 2005; formerly "*Psilocybe cyanescens* complex") growing in detritus (mostly on woody debris) in Central Europe. It does not include the following graminicolous or coprophilous bluing species: *P. fimetaria* (P. D. Orton) Watling, *P. gallaeciae* Guzmán et M. L. Castro, *P. hispanica* Guzmán, *P. liniformans* Guzmán et Bas, *P. puberula* Bas et Noordel., *P. semilanceata* (Fr.) P. Kumm., and *P. strictipes* Singer et Smith (*P. callosa* auct.). Besides, the closely related but poorly known species *P. mairei* Singer described from North Africa and *P. medullosa* (Bres.) Borovička, that does not stain blue, are not included.

MATERIALS AND METHODS

Fresh fruitbodies of *P. bohemica*, *P. arcana*, *P. moravica* var. *moravica* and *P. moravica* var. *sternberkiana* were collected and studied from many sites in the Czech Republic. Except for *P. moravica* var. *sternberkiana*, all species were studied for 4–9 years at their localities. Two collections of fresh, outdoor cultivated fruitbodies of *P. cyanescens* and *P. azurescens* (grown in a city park from fungal strains obtained from North America) were donated from Austria. In addition, specimens of all studied species from the following herbaria were examined: B, BRA, BRNM, CB, CNF, E, GENT, HR, IB, K, L, LUG, O, PRM, UBC, WTU and WU. Several herbarium collections were donated from Austria, Belgium, Croatia, France, Germany, Greece, Hungary, Italy, Switzerland, the United Kingdom and the USA; these and the collections from the Czech Republic identified by the author are deposited in the herbarium of the Mycological Department, National Museum, Prague (PRM). Acronyms of herbaria are according to Holmgren and Holmgren (1998).

Despite the fact that many collections can be easily identified in the field (or even in a photograph) just by macrocharacters, a microscopic study is necessary for unambiguous identification. Therefore, the key is mainly based on microcharacters. These were studied mostly on dried fruitbodies. Observations and measurements were made on material mounted in a 5 % KOH aqueous solution and/or Congo Red.

The most important microscopic features are: the shape of pleurocystidia and their occurrence on the lamella surface, shape of cheilocystidia, and size and shape of spores. Pleurocystidia should be observed on the whole surface of the lamellae, not only near the edge. Spores were measured only in mature fruitbodies. Maximum and minimum length/width values of spore size are given in brackets and represent the 95th and 5th percentiles, respectively. Spore length/width quotients (Q-values) were calculated from a large number of measurements (50–190 spores per species) and are presented as minimum, median and maximum, respectively.

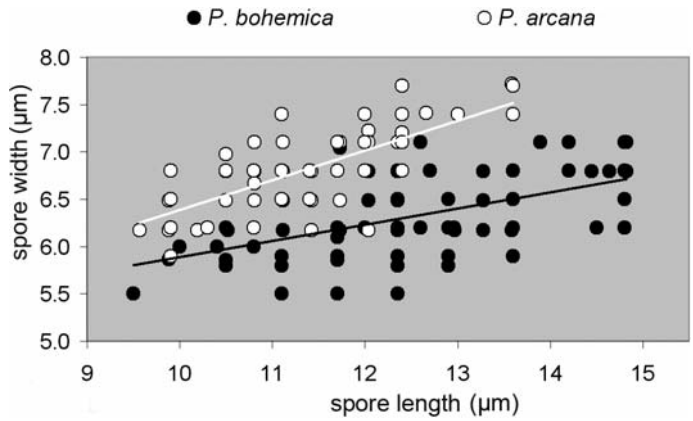

Fig. 1. Spore size in *Psilocybe bohemica* (3 collections, 90 spores) and *Psilocybe arcana* (3 collections, 90 spores), linear regression indicated.

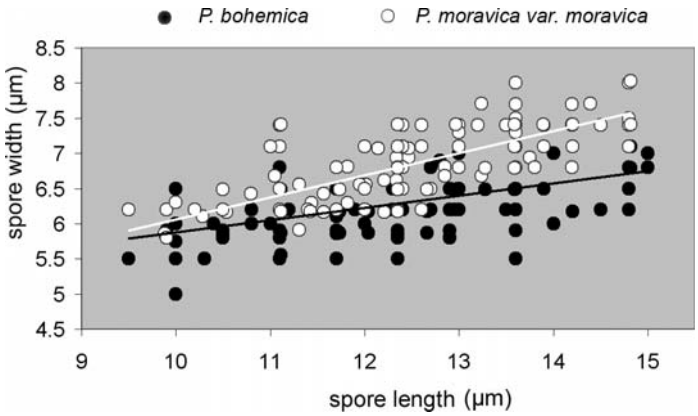

Fig. 2. Spore size in *Psilocybe bohemica* (7 collections, 190 spores) and *Psilocybe moravica* (8 collections, 190 spores), linear regression indicated (from Borovička 2003).

Despite an overlap in spore size of particular species (couplets 3 and 6 in the key below), measurement of a representative number of spores (20–30) should clearly reveal the difference between the species as shown in Figs. 1 and 2. Especially the relative frequency of particular length and/or width sizes should be considered.

Macrocharacters are given as important supplementary features; only distinguishing macrocharacters are mentioned. Data on distribution and phenology are mainly based on the author's own observations from Central Europe.

An extensive list of previously published illustrations of the *Psilocybe* species referred in the key is included. Clearly misapplied illustrations are mentioned as "excluded"; question marks indicate the author's doubts about some of the illustrations.

RESULTS AND DISCUSSION

Characteristics of included taxa. Autumnal species (September–December) growing in detritus, mostly on woody debris, also on fallen decayed trunks, seed cones or acorns, mostly in broadleaved or mixed forests, less commonly in coniferous forests, often along forest paths or roads, in gulches near creeks, in underbrush with *Urtica* spp. or *Rubus* spp., also in parks, gardens and cemeteries (wood chips), mostly gregarious, on various types of bedrock. Little to almost middle-sized, might resemble *Hypholoma subericaeum*, *H. myosotis* or some *Psathyrella* species. Staining blue, blue-green or olive-green on stipe or pileus spontaneously or when bruised. All species contain the psychoactive compounds psilocybin and psilocin (see Wurst et al. 2002, Stříbrný et al. 2003, Courtecuisse and Deveaux 2004).

KEY

1a Pleurocystidia present, quite frequent to very abundant, only rarely scarce, clavate-mucronate, broadly fusiform or robustly lageniform (Fig. 3a). Cheilocystidia lageniform, mostly with a rather short neck (< 10 µm), also pleurocystidia-shaped. Growing mostly in gardens, parks and cemeteries. ..... stirps ***Cyanescens*** (Borovička 2005) 2

1b Pleurocystidia scarce to abundant, lageniform (Fig. 3b), or absent. Cheilocystidia lageniform, with a short or a long neck (> 10 µm), also fusiform or very narrowly cylindrical, equal or flexuous (Figs. 3d–e). Growing in natural habitats or man-made forests, often in pathsides, along creeks etc. ..... stirps ***Serbica*** (Borovička 2005) 3

2a Spores ellipsoid to broadly ellipsoid, (9.8–)10.0–12.5(–13.5) × (6.5–)7.0–7.5(–8.0) µm [Q = 1.3–1.6–1.8]. Pileus usually up to 5 cm across, not acutely umbonate, margin wavy and/or expanded at maturity. Stipe up to 10 cm long, whitish, silky fibrillose; fibrillose annular zone absent. ..... ***Psilocybe cyanescens*** Wakef.

2b Spores ellipsoid, (11.0–)12.0–13.5(–14.8) × (6.8–)7.2–7.7(–8.0) µm [Q = 1.65–1.8–1.95]. Fruitbodies relatively large, pileus 3–6(–10) cm across, mostly acutely umbonate, margin not wavy. Stipe up to 20 cm long, silky fibrillose but at maturity also with silvery fibrillose velar remnants on dark back-

ground in lower part, often with a fibrillose annular zone in upper part, this coloured purplish brown by spores. .....***Psilocybe azurescens*** Stamets et Gartz

3a Spore length on average < 11.7 µm, spores only rarely longer than 13 µm (see Fig. 1). 4

3b Spore length on average > 12.2 µm, spores commonly longer than 13 µm (see Fig. 2). 5

4a Pleurocystidia lageniform, frequent to abundant. Cheilocystidia lageniform, often with a distinctly elongated neck [10–20(–25) µm long], also very narrowly cylindrical, straight or flexuous (Fig. 3e). .....***Psilocybe serbica*** M.M. Moser et E. Horak

4b Pleurocystidia absent. Cheilocystidia lageniform, mostly with a relatively short neck (up to 10 µm long), or fusiform (Fig. 3d). .....***Psilocybe arcana*** Borovička et Hlaváček

5a Spores very large, elongate-ellipsoid, (11.0–)12.5–16.0(–17.3) × (6.2–)6.5–7.4(–7.7) µm [Q = 1.7–1.9–2.5]. Other features similar to *P. moravica* var. *moravica* (6b). .....***Psilocybe moravica*** var. ***sternberkiana*** Borovička

5b Spores smaller. 6

6a Spores ellipsoid to elongate-ellipsoid, (10.5–)11.0–13.6(–15.0) × (6.0)6.2–6.8(–7.1) µm [Q = 1.7–1.95–2.4] (see Fig. 2). Pileus pale caramel-brown when moist, fading to pale coffee-white. Lamellae mostly pale brownish or pale ochraceous with somewhat paler margin (almost concolorous), ventricose, adnate, but often slightly subdecurrent. Well-developed fibrillose annular zone on stipe absent. ..... ***Psilocybe bohemica*** Šebek ex Šebek

6b Spores ellipsoid, not elongated, (10.5–)11.0–13.6(–14.7) × (6.2–)6.5–7.1(–7.5) µm [Q = 1.5–1.8–2.0] (see Fig. 2). Pileus variably coloured when moist, brown (orange-brown, olive-brown, ochre brown), with a grey and/or olive tinge, fading to yellowish-white, beige or ochraceous (often with a grey tinge). Lamellae dark brown, often with a grey tinge and white edge, usually broadly ventricose at maturity, adnate (not subdecurrent). Partially or well-developed fibrillose annular zone on stipe often present, this coloured purplish brown by spores. ..... ***Psilocybe moravica*** Borovička var. ***moravica***

Simple drawings of the characteristic appearance of *P. cyanescens*, *P. azurescens*, *P. arcana*, *P. bohemica* and *P. moravica* are presented in Figs. 4a–e.

NOTES

Psilocybe cyanescens Wakef., Trans. Br. Mycol. Soc. 29: 141 (1946)

The wavy pileus margin, which occurs in the most of mature fruitbodies, is a characteristic feature of this species. However, this shape might be also (even if rarely) present in all other *Psilocybe* species of the stirps *Serbica* (extremely rare in *P. bohemica*, very rare in *P. arcana*, and uncommon in *P. moravica*). Growing in groups, but also clustered. According to some authors and my own observation, it is also characterised by a farinaceous smell.

Distribution. An American species, introduced to Europe (Borovička 2005). It is widespread in Western Europe, but rare, almost only found in botanic gardens, parks and cemeteries. I have studied collections from Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom (of countries outside Europe I have studied collections from the USA and Canada). Undoubtedly, this species was also found in Denmark (Klug-Andersen 1994) and might occur in other European countries as well.

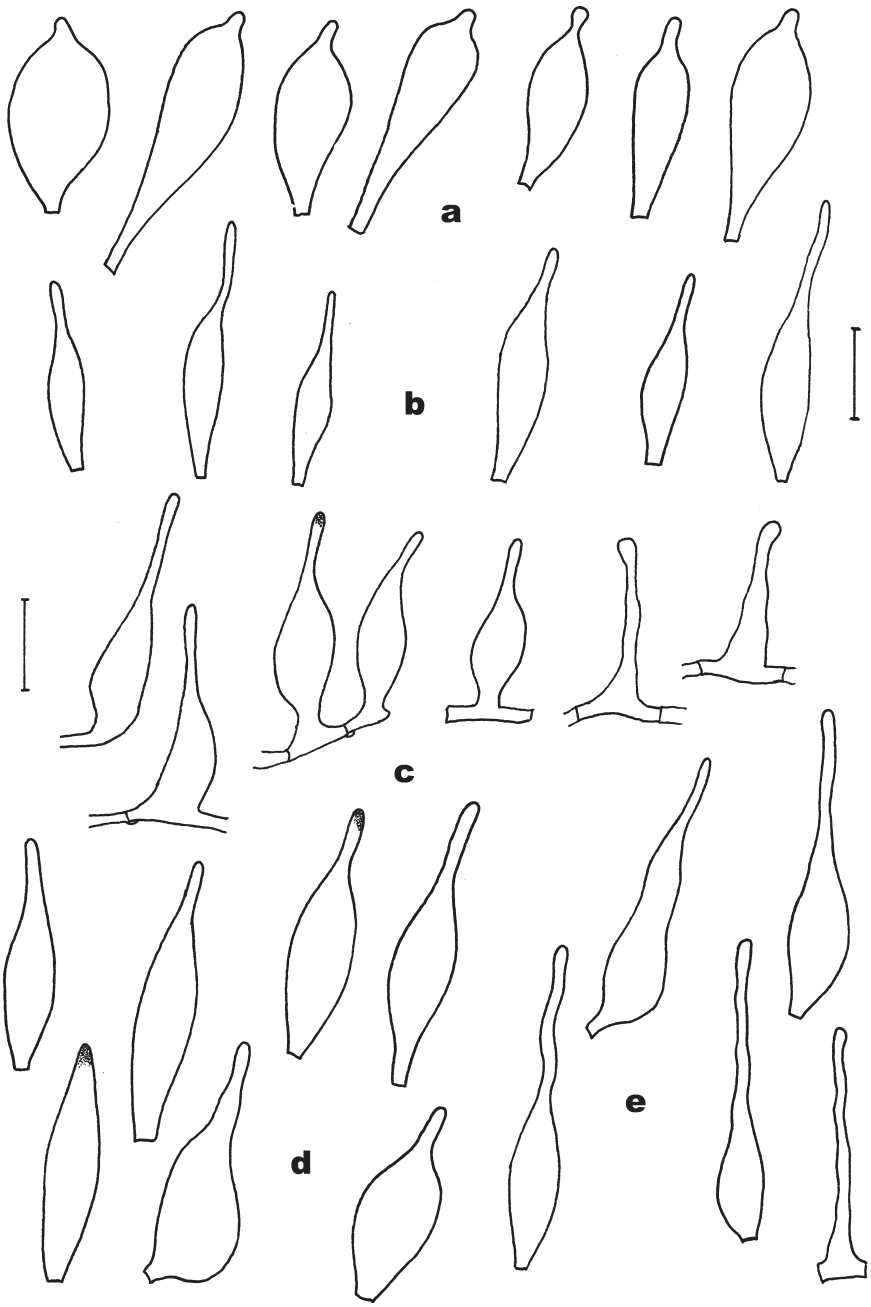

Fig. 3. Microcharacters. a – pleurocystidia, stirps *Cyanescens*. b – pleurocystidia, stirps *Serbica*. c – cheilocystia arising from hyphae parallel to the edge of the lamella, stirps *Serbica*. d – cheilocystidia in *P. arcana*. e – cheilocystidia in *P. serbica*. Scale bar = 10 µm.

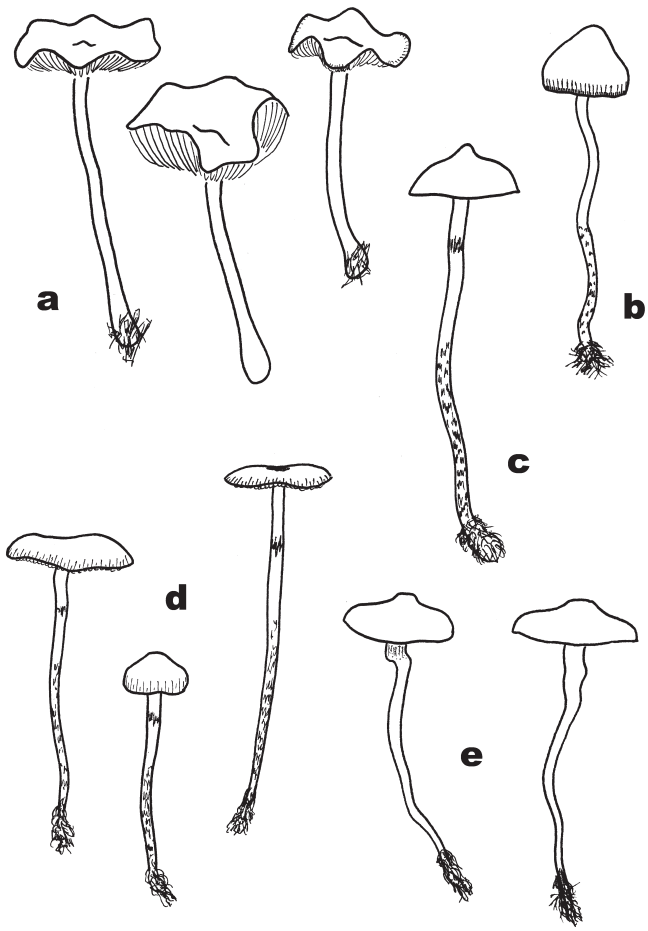

Fig. 4. Macrocharacters. a – *P. cyanescens*. b – *P. bohemica*. c – *P. azurescens*. d – *P. moravica*. e – *P. arcana*.

Phenology. September–November, fructification maximum in October.

Selected illustrations. Anonymus (2000, p. 29), Arnolds et al. (1995, pl. 13a), Assisi et al. (2008, p. 81, fig. d; p. 83), Borovička (2005, figs. 3–10), Gartz (1996, fig. 3), Gartz (1999, figs. 3.1–3.3), Gartz (2001, p. 22), Eul (1999, p. 49; 3 fruitbodies in the right), Evans and Kibby (2004, p. 48), Guinberteau (2007, p. 91), Guzmán (1983, plate 2), Harris (1989, p. 85), Klug-Andersen (1994, p. 37), Læssøe and Del Conte (1997, p. 156), Lincoff (1998, fig. 31), Lucchini (1997, p. 403, fig. 0759), Ludwig (2000, fig. 72.13.A), Menser (1997, fig. 20, p. 87), Nicholas and Ogamé (2006, p. 55), Noordeloos (1999, fig. 23), Pegler and Legon (1998, p. 181), Phillips (1981, p. 172), Riva (1995, p. 3), Riva (2002, p. 267), Stamets (1978, fig. 18), Stamets (1996, p. 28 and

p. 111), Stamets (2000, p. 327, 1 colour plate), Stamets (2005, fig. 342), Stamets and Gartz (1995, fig. 5), ? Stijve (2004, fig. 2), Tjallingii-Beukers (1976, p. 39).

Excluded illustrations. Abhardt and Lohmeyer (2001, p. 154), ? Arora (1986, plate 88), Assisi et al. (2008, p. 302), Babos (1997, p. 11), Boccardo et al. (2008, fig. 769), Bon and Roux (2003, p. 48), ? Cetto (1995, fig. 913), Eul (1999, p. 49; 5 fruitbodies in the left), Follesa et al. (2006, p. 74), Gartz (1996, fig. 2), Gartz (1999, figs. 3.4 and 10.1), Grilli (1990, p. 116–119), Hagara et al. (1999, fig. 366), Hlaváček (1996, fig. 1), Krieglsteiner (1984, 1 colour plate), Kunc (1981, appendix, figs. 2 and 3), Mao (2000, figs. 646 and 647), Michael et al. (1985, fig. 265b), Moser and Jülich (1996, pl.: III *Psilocybe* 10), Pilát (1969, fig. 27), Roux (2006, p. 901).

Note. An error occurred in my study on *P. cyanescens* (Borovička 2005); see the correction in Mykol. Sborn. 82(3): 112.

Collections examined. B 700000536, E 186682, E 186684, E 186685, E 186686, E 186687, K (M) 85041, K (M) 28453, K (M) 85043, K (M) 31416, K (M) 63976 (holotype), L 0194081, LIP PAM3110805 [duplicate: PRM 909549], LUG 7565, PRM 893653, PRM 896513, PRM 901021, PRM 901040, PRM 901480, PRM 901481, PRM 901482, PRM 901838, PRM 902040 [ex GENT], PRM 902041, PRM 902042, PRM 902043, PRM 902044 [ex GENT], UBC (F) 577, UBC (F) 1503, UBC (F) 1512, UBC (F) 1513, UBC (F) 10095, and UBC (F) 12155.

Psilocybe azurescens Stamets et Gartz, Integration 6: 21 (1995)

P. azurescens is a distinct species, closely related to *P. cyanescens*. It can be easily distinguished by macrocharacters (acutely umbonate pileus and fibrillose annular zone on stipe) and microcharacters (longer spores).

Distribution. An American species, introduced to Europe; for the first time reported from a natural habitat in Germany (Gminder 2001). Its occurrence in Europe has most likely been caused by recent amateur outdoor cultivation; next finds are expected in the future. I have also studied one collection found on 19th October 1966 in Royal Botanic Garden Edinburgh (E 186683) that might be attributed to this species; however, the herbarium specimen was in a bad state and not all the features necessary for doubtless identification could be observed.

Phenology. Probably similar to *P. cyanescens*.

Selected illustrations. Gartz (1999, figs. 11.1–11.4), Gminder (2001, p. 32–33), Stamets (1996, p. 94–95), Stamets (2000, p. 330, 1 colour plate), Stamets (2005, figs. 124 and 348), Stamets and Gartz (1995, figs. 1 and 2).

Collections examined. ? E 186683, PRM 857489, PRM 901020, PRM 901174 [duplicate: STU], PRM 905516, and WTU (21 Nov. 1993 leg. P. Stamets, isotype).

Psilocybe serbica M. M. Moser et E. Horak, Z. Pilzk. 34(3–4): 138 (1968)

P. serbica is a very poorly known species (for example, only one colour photo is available) and further investigation on its morphological variability, distribution and relationship to other similar bluing species is required.

Fig. 5. *Psilocybe cyanescens* Wakef., France. Photo courtesy of Jacques Guinberteau.

Fig. 6. *Psilocybe arcana* Borovička et Hlaváček, Czech Republic, nearby the holotype locality. Photo by Jan Borovička.

Fig. 7. *Psilocybe arcana* Borovička et Hlaváček, Czech Republic, nearby the holotype locality. Photo by Jan Borovička.

Fig. 8. *Psilocybe bohemica* Šebek ex Šebek, Czech Republic, locality of epitype. Photo by Jan Borovička.

According to the original description (Moser and Horak 1968), *P. serbica* is a relatively small species. Spores are (9.0–)10.0–12.0(–13.3) × (6.1–)6.5–7.5(–7.8) µm [Q = 1.5–1.65–1.8] (measured on holotype and isotype: IB 1963/0727; herb. E. Horak 66/28). According to Moser and Horak (1968), pleurocystidia are absent (Latin diagnosis, p. 138); however, presence of pleurocystidia is thereafter reported (p. 140). My study of the holotype and paratype collections of *P. serbica* (IB 1963/0727; herb. E. Horak 63/253) has revealed that pleurocystidia are common or even abundant on the whole surface of the lamellae. I have also observed abundant lageniform pleurocystidia in other collections from southern Austria and Croatia which might be attributed to *P. serbica* (B 700000527, CNF 1/2777, and CNF 1/3194). Therefore, pleurocystidia are present and frequent in *P. serbica*. Guzmán (1983) has reported that cheilocystidia in *P. serbica* often arise from hyphae parallel to the edge of the lamella (Fig. 3c); I have commonly observed this feature also in other species of the stirps *Serbica*.

An unusual combination of characters has been observed in a collection of *Psilocybe* cf. *serbica* (pleurocystidia common, long-necked cheilocystidia rare) found in Italy (PRM 846609). Two collections quite similar to *P. serbica* have also been studied from the Czech Republic (PRM 846609 and PRM 905477).

Distribution. Described from Serbia. I have also studied herbarium collections corresponding to *P. serbica* found in Austria, Croatia, and the Czech Republic (Moravia). Probably a submontane or montane species.

Phenology. Examined collections were found in September and October.

Selected illustrations. Moser and Horak (1968, figs. 1a–d, 2a–c, and 3c), Moser and Jülich (1996, pl.: III *Psilocybe* 5, holotype), Stamets (1996, p. 145).

Excluded illustrations. ? Guzmán (1983, fig. 761), ? Guzmán et al. (1998, fig. 31).

Collections examined. B 700000527, CNF 1/2777, CNF 1/3194 [duplicate: PRM 903176], herb. E. Horak 66/28 (isotype), herb. E. Horak 63/253 (paratype), IB 1963/0727 (holotype), PRM 846609, and PRM 905477.

Psilocybe arcana Borovička et Hlaváček, Mykol. Sborn. 78(1): 2 (2001)

The appearance of *P. arcana* frequently resembles *Hypholoma subericaeum*. Pileus mostly obtusely umbonate, up to 5(–7) cm across, orange-brown or dark chocolate-brown when moist, often with an olive tinge, fading to yellowish white or dirty white. Stipe up to 12 cm long, deformed (flexuous and/or flattened) in the upper part, usually distinctly attenuated downwards (never enlarged at base), with white clusters of rhizomorphs, whitish or with a pale yellowish tinge, surface faintly pruinose and striate at apex, silvery velar remnants usually absent. Lamellae dark chocolate brown with a distinct purple tinge at maturity, with a white edge, adnate to adnexed (not subdecurrent). Pileus and stipe turn blue-

green or green when bruised or spontaneously, especially on drying. Smell radish-like, taste bitter-radish and somewhat astringent. Spores in *P. arcana* are of the same size as in *P. serbica*, (9.8–)10.5–12.5(–13.5) × (6.2–)6.5–7.1(–7.4) µm [Q = 1.5–1.7–1.85]. Basidia 4-spored, with relatively short sterigmata (3.5–5 µm).

P. serbica is a closely related species. However, it can be distinguished by frequent pleurocystidia and by cheilocystidia with an often distinctly elongated neck (Fig. 3e) – see also Moser and Horak (1968; figs. 1d and 2a) and Guzmán and Bas (1977; fig. 7). Moreover, an obtusely umbonated pileus and stipe distinctly attenuated downwards have not been reported for *P. serbica*.

Distribution. Rather common in certain areas of the Czech Republic (circa 60 localities confirmed by the author), mostly in broadleaved forests (*Quercus*, *Fraxinus*, *Acer*), but also under conifers (e.g., *Pinus*). Several collections have been studied from Austria, Hungary, Norway and Slovakia.

Phenology. September–November, fructification maximum in October.

Selected illustrations. Anonymus (2003, p. 61), Assisi et al. (2008, p. 300), Babos (1997, p. 11), Borovička (2005, figs. 11 and 12), Borovička and Hlaváček (2001a, 3 colour plates, front cover photo), Borovička and Hlaváček (2001b, 1 colour plate; as "*P. oreana*"), ? Hagara et al. (1999; as *P. cyanescens*), Hlaváček (1996, fig. 1; as *P. cyanescens*), Moser and Jülich (1996, pl.: III *Psilocybe* 10; as *P. cyanescens*), Papoušek (2004, fig. 683).

Collections examined. BRA (17 Sept. 1979 leg. J. Kuthan), BRNM 299093, BRNM 305602, BRNM 305899, BRNM 331852, BRNM 331878, BRNM 331900, BRNM 331908, BRNM 331912, BRNM 457798, BRNM 576733, BRNM 642448, BRNM 648564, BRNM 648608, BRNM 648614, CB 6880, HR 26638, HR 28926, HR 45436, HR 45470, HR 47855, L (9 Oct. 2006 leg. J. Borovička), O 177904, PRM 813470, PRM 857426, PRM 891564, PRM 891566, PRM 895093 (holotype), PRM 896507, PRM 896508, PRM 896509, PRM 896510, PRM 901040, PRM 901171, PRM 901172, PRM 901642, PRM 901643, PRM 901644, PRM 901646, PRM 901647, PRM 905466, PRM 905467, PRM 905476, PRM 905480, PRM 905482, PRM 905513, PRM 915262, WU 7985, and ZT (Myc) 301.

Psilocybe moravica* var. *sternberkiana Borovička, Czech Mycol. 58(1–2): 76 (2006)

I have seen only two fresh collections (holotype and paratype) whose macrocharacters were similar to *P. moravica* var. *moravica*.

Distribution. Known from just two neighbouring sites in the Czech Republic (Moravia) and one site in Germany (Bavaria).

Phenology. Probably similar to *P. moravica* var. *moravica*; holotype and paratype collections were found on 1 November and 26 October, respectively.

Selected illustrations. Borovička (2006, fig. 2).

Collections examined. PRM 901650 (holotype), PRM 901651 (paratype), and PRM 905446.

Fig. 9. *Psilocybe bohemica* Šebek ex Šebek, Czech Republic, locality of epitype. Photo by Jan Borovička.

Fig. 10. *Psilocybe moravica* Borovička, Czech Republic, locality of holotype. Photo by Jan Borovička.

Fig. 11. *Psilocybe moravica* Borovička, Czech Republic, locality of holotype. Note the broadly ventricose lamellae. Photo by Jan Borovička.

Fig. 12. *Psilocybe moravica* var. *sternberkiana* Borovička, Czech Republic, holotype (PRM 901650). Photo by Jan Borovička.

Psilocybe bohemica Šebek ex Šebek, Česká Mykol. 37(3): 177 (1983)

P. bohemica is a very distinct species characterised by its relatively slender fruitbodies, pale caramel-brown pileus (never orange-brown or reddish-brown), fading to pale coffee-white or whitish (not yellowish). Stipe narrowly cylindrical, not enlarged either at base or at apex, with tiny silvery fibrillose velar remnants in lower part and white clusters of rhizomorphs at base. Smell weakly radish with a distinct sweet (cocoa-like) component. Spores elongate-ellipsoid and relatively narrow, often scarce even in mature fruitbodies. Pleurocystidia present, but usually scarce or difficult to find, especially in dried specimens.

Distribution. Known from approx. 25 localities in the Czech Republic and perhaps from Austria (Michael et al. 1981). It occurs especially in moist localities along creeks and in gulches. Red-listed in the Czech Republic (Borovička 2006, considered „endangered“). Unfortunately, Jochen Gartz (1999) in his popular book „Narrenschwämme“ unwisely published the position of the original (epitype) locality in the Czech Republic. The Czech edition of his book revealed the locality to many „magic mushroom hunters“ and caused serious damage to this site.

Phenology. October–December, fructification maximum in November (cold-adapted species); in mild winters, solitary specimens can be also found in January and February.

Selected illustrations. Anonymus (2003, p. 50 and 246), Assisi et al. (2008, p. 301), Borovička (2002, 1 colour plate), Borovička and Hlaváček (2001b, fig. 11, 3 colour plates, front cover photo), Gartz (1996, fig. 1), Hagara et al. (1999, fig. 367), Herink (1950; as *Hypholoma coprinifacies*), Hlaváček (1996, fig. 2, 1 black-and-white plate), Kubička and Kluzák (1985, fig. 2; as *P. mairei*), Kunc (1981, appendix, figs. 2 and 3; as *P. cyanescens*), ? Michael et al. (1981, fig. 265b; as *P. cyanescens*), Moser and Horak (1968, fig. 3b; as *P. coprinifacies*), Pilát (1951, fig. 335, 528, 528b; as *Hypholoma coprinifacies*), Pilát (1969, fig. 27; as *P. cyanescens*), Pilát and Ušák (1959, t. 128b; as *Hypholoma coprinifacies*), Příhoda (1972, fig. 136; as *Stropharia coprinifacies*), ? Semerdžieva and Nerud (1973, fig. 2; as *P. coprinifacies*), Semerdžieva and Wurst (1986, p. 65), Šebek (1975, fig. 1), Šebek (1983, p. 178), Stamets (1996, p. 99), ? Wichanský (1969, fig. 5; as *Hypholoma coprinifacies*), Wurst et al. (2002, fig. 6).

Excluded illustrations. Gartz (1999, fig. 4.1), ? Guzmán et al. (1998, fig. 21).

Collections examined. BRNM 590492, HR 45499, HR 48382, HR 49755, L (10 Nov. 2006 leg. J. Borovička), PRM 617559, PRM 671926, PRM 829237 (epitype), PRM 829241 (holotype), PRM 842619, PRM 846608 [duplicate: L], PRM 857427, PRM 857430, PRM 857441, PRM 877941, PRM 895094, PRM 896511, PRM 896512, PRM 901041, PRM 901175, PRM 901176, PRM 901177, PRM 901648, PRM 901649, PRM 901836, PRM 901837, PRM 902038, PRM 902039, PRM 905481, PRM 905483, PRM 905484, PRM 909886, PRM 909887, and PRM 909969.

Psilocybe moravica Borovička **var. *moravica***, Mykol. Sborn. 80(4): 127 (2004)

P. moravica can be recognised by the following combination of macrocharacters: pileus often not umbonate, convex, sometimes nearly plane or almost hemispherical, margin sometimes somewhat wavy at maturity, lamellae with a grey tinge and broadly ventricose at maturity, stipe with silvery velar remnants on dark background and often with a well-developed fibrillose annular zone (this feature has never been observed in any other *Psilocybe* species of the Stirps *Serbica*). Microscopically, *P. moravica* is characterised by relatively large spores, clearly broader than in *P. bohemica* (Fig. 2). The normal spore length range is 11.0–13.5 µm, longer spores are relatively rare in some collections. Pleurocystidia are present (scarce to abundant), basidia 4– and 2-spored, often with markedly large sterigmata, 4–6(–8.5) µm long.

P. moravica can be confused with *P. arcana*. However, the latter species is characterised by its somewhat smaller spores, absence of pleurocystidia, basidia with small sterigmata (up to 5 µm long), chocolate-brown lamellae with a purple tinge, a stipe often enlarged (deformed) at apex and always lacking a fibrillose annular zone.

Distribution. Known from more than 15 localities in the Czech Republic (Moravia), Austria, Italy and Slovakia.

Phenology. September—November; it can be also found in July or August, if the summer season is cold; fructification maximum in October/November.

Selected illustrations. Assisi et al. (2008, p. 298–300), Borovička (2003, figs. 10 and 11, 9 colour plates), Borovička (2006, fig. 1), Galli (2003, p. 44; as *P. cyanescens*), Galli (2005, p. 53; as *P. cyanescens*), ? Gartz (1996, fig. 2; as *P. cyanescens*), ? Gartz (1999, fig. 3.4; as *P. cyanescens*).

Collections examined. BRA CR3465, BRA CR3466, BRA (16 Oct. leg. J. Kuthan), BRNM 331888, L (19 Oct. 2006 leg. J. Borovička), PRM 851189, PRM 895095, PRM 900455 (holotype), PRM 900987, PRM 900988 (paratype), PRM 900989, PRM 900990, PRM 900991 (paratype), PRM 900992 (paratype), PRM 901022, PRM 901023, PRM 905435, PRM 905485, PRM 905486, PRM 905487, PRM 905488, PRM 905501, and PRM 905515.

I have been studying the species of the stirps *Serbica* at their original localities in the Czech Republic for years and I have observed that the combinations of characters described above are constant; no intermediate collections have been found. On the other hand, I have seen several aberrant (or intermediate) collections from various sites in Europe, especially as herbarium specimens (IB 78/422, PRM 846609, PRM 869528, PRM 901024, PRM 901173, PRM 901178, PRM 905505, PRM 909789, PRM 909889 and PRM 909970).

Moser and Jülich (1996, pl.: III *Psilocybe* 5) reported a colour photo of „*Psilocybe callosa*“. However, *Agaricus callosus* is a synonym of *Panaeolus papilionaceus* (Bull.) Quél. (Guzmán 1995), and *P. callosa* sensu Guzmán (1983),

auct. is *Psilocybe strictipes* Singer et A. H. Smith – a graminicolous or somewhat coprophilous species close to *Psilocybe semilanceata*. The specimens in the photo reported by Moser and Jülich are evidently a wood-rotting bluing *Psilocybe* species. My revision has revealed that this collection (IB 78/422) belongs to the stirps *Serbica* and, curiously enough, its microcharacters are quite similar to *P. serbica*. Therefore, I consider it an aberrant collection.

I have not seen a sufficient number of collections of the stirps *Serbica* collected outside the Czech Republic. Some unusual bluing *Psilocybe* species found in the Mediterranean have been also reported in literature (Cetto 1995 – fig. 912, as *P. cyanescens*; Cetto 1995 – fig. 913, as *P. phyllogena*; Grilli 1990, as *P. cyanescens*; Guzmán et al. 2002, as *P. cyanescens*). Some *Psilocybe* species of the stirps *Serbica* might also be depicted in Ludwig (2000, fig. 72.10, as *P. strictipes*).

Last but not least, the species *Psilocybe mairei* Singer (1973), syn. *Hypholoma cyanescens* R. Maire, which was described from Algeria, would have priority over some other species, e. g. *P. arcana*, which seems to be closely related. However, our knowledge of the genuine *P. mairei* is based on just three descriptions (Maire 1928, Malençon 1942, Malençon and Bertault 1970) and is thus limited. A discussion should be initiated when more data and herbarium specimens are available from Algerian or Moroccan localities.

It should be stressed that the *Psilocybe* species referred in this key represent, with no doubt, two distinct groups. However, the presented concept of species within the stirps *Serbica* is still questionable, since intermediate collections have been observed. There is no doubt that especially DNA studies based on the present knowledge of European bluing species might help to answer some of the questions that still remain.

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