Pholiotina atrocyanea, spec. nova, and three other rare *Pholiotina* species (*Bolbitiaceae*, *Agaricales*) from Spain

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Abstract: Four rare or interesting species of *Pholiotina* collected in Spain are described and discussed: *P. aporos*, *P. sulcata*, *P. velata*, and the new species *P. atrocyanea*, which is close to *P. aeruginosa*, and is characterised by dark blue-green pileus and constantly 2-spored basidia. Line-drawings and colour photographs are presented.

Zusammenfassung: Vier seltene oder interessante, in Spanien gesammelte *Pholiotina*-Arten werden beschrieben und diskutiert: *P. aporos*, *P. sulcata*, *P. velata* und die neue Art *P. atrocyanea*, die *P. aeruginosa* nahesteht und durch dunkel blaugrüne Hutfarbe sowie konstant zweisporige Basidien charakterisiert ist. Zeichnungen und Farbfotos werden präsentiert.

During the last years, the first author collected some *Pholiotina* specimens from the Iberian Peninsula. A few of them turned out to be rare or were previously not recorded from this territory. *Pholiotina sulcata* was only known in Spain from one earlier record (ESTEVE-RAVENTÓS 1988), and is presented here with a colour photograph, as well as *P. velata*. Finally, a dark blue-green species is described as new, *P. atrocyanea*. It is compared with *P. aeruginosa* (ROMAGN.) M. M. MOSER, also very rare and hardly recorded in Europe (see HAUSKNECHT 2007).

List of species

***Pholiotina aporos* (KITS VAN WAV.) CLÉMENÇON** (Fig. 1 a-d)
≡ *Conocybe aporos* KITS VAN WAV.
= *Pholiota togularis* sensu J. E. LANGE

Material studied: Spain: Guadalajara, Retiendas, proximidades del Monasterio del Bonaval, 30TVL 7535, 825 m s. m., 1. 5. 2007, in fresh humus under *Populus nigra* L., on clayey soil, leg. F. ESTEVE-RAVENTÓS, AH 36086.

Characters (based on one single specimen):

Pileus: 1 cm in diam., at first campanulate to convex, finally plano-convex, not or hardly umbonate; margin hardly striate when humid, without rests of veil; surface smooth, dull, hygrophanous, dark orange-brown to amber when humid, becoming orange to dark ochraceous when drying, somewhat darker at disc.

Stipe: 3.5 × 0.15 cm, cylindrical, slender, fistulose, yellowish to ochraceous-brown, darkening from base upwards; surface minutely floccose at apex, fibrillose downwards; membranous ochraceous-whitish veil present, either as a complete ring sulcate above or broken partially and adhered to the upper third of the stipe.

Lamellae: more or less crowded, ventricose, ascendant, narrow, at first ochraceous, becoming orange-brown; lamellar edge minutely fimbriate, whitish or paler.

Context: brownish or darker at stipe base; smell weak or hardly acidulous, taste not recorded.

Basidiospores: 7.5-9 × 4.3-5.2 µm, ellipsoid to oblong, sometimes subamygdaliform in side view, smooth, orange in ammonia solution, without apical germ-pore and moderately thick-walled.

Basidia: 4-spored, clavate, 18-25 × 5-8 µm.

Clamp connections: present.

Cheilocystidia: numerous, rendering the lamellar edge heterogeneous, 30-50 × 5-8 µm, subcylindrical, narrowly clavate or more rarely sublageniform, and then with sinuose neck, sometimes showing shallow lobes like in some *Mycena* species.

Pileipellis: a hymeniderm, with encrusting to parietal brown-orange pigment.

Phenology and habitat: gregarious to solitary, mostly in spring, in clayey soils under deciduous trees, in open and fresh woods, gardens, parks, roadsides, near paths, etc.

Distribution: Europe, especially well known in central European countries; it seems widespread but rare. Apart from this record, it has only been cited twice in the Iberian Peninsula, from Catalunya (ROCABRUNA 1999) and recently from Andalusia (DANIËLS & MORENO-ARROYO 2006).

It is very rare outside of Europe, the second author has studied only few collections from Africa (Morocco), and North America (USA).

Comments: see WATLING (1982), ENDERLE (1991), LONATI (1993), and ARNOLDS (2005). The early phonological appearance (though it can seldom be collected in autumn) and typical basidiospores devoid of a germ-pore are diagnostic among the annulate species of the genus. The single specimen studied was easily identified on the basis of its microscopic characters.

***Pholiotina atrocyanea* ESTEVE-RAV., HAUSKN. & REJOS, spec. nova** (Figs. 1 e-i, 3 a)

Latin diagnosis: *Pholiotinam aeruginosam* (ROMAGN.) M. M. MOSER accedit sed ab ea praecipue basidiis bisporis coloribus pilei uniformiter caeruleo-viridibus vel atrocyaneis differt. A *P. aeruginosa* var. *caeruleopallida* HAUSKN. basidiis bisporis coloribus pilei intensioribus atque sporis crassius tunicatis poro germinativo non distincte papillato differt. In silvis mediterraneis (*Quercus faginea, Q. ilex, Cistus*).

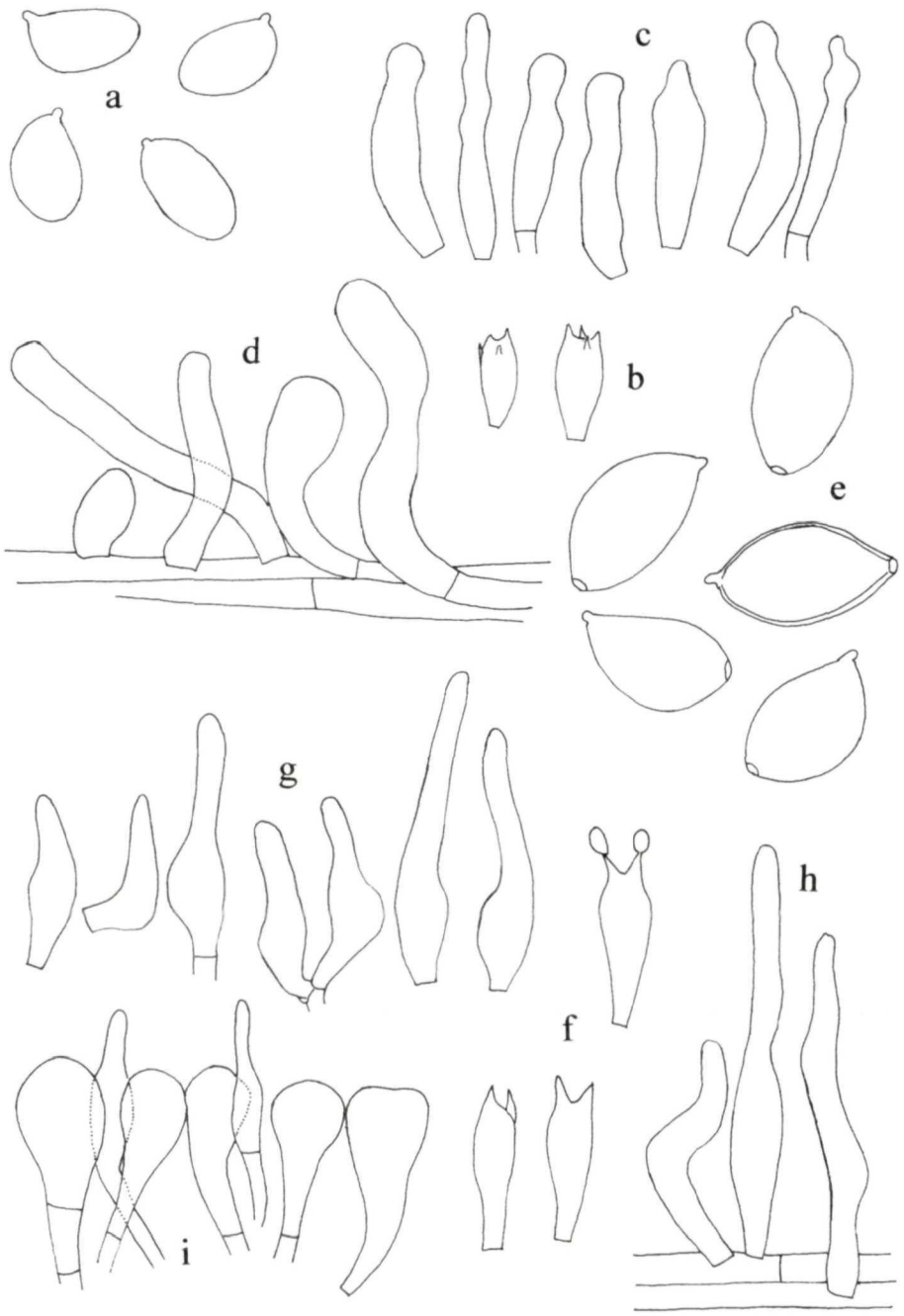

Fig. 1 *a-d. Pholiotina aporos* (AH 36086). *a* spores, × 2000, *b* basidia, × 800, *c* cheilocystidia, × 800, *d* caulocystidia, × 800. *e-i. Pholiotina atrocyanea* (holotype). *e* spores, × 2000, *f* basidia, × 800, *g* cheilocystidia, × 800, *h* caulocystidia, × 800, *i* pileipellis with pileocystidia, × 800.

Typus: Spain, Guadalajara, Casa de Uceda, 30TVL6823, 770 m s. m., 23. 10. 2003, solitary in soil among mosses under *Quercus faginea* ("quejigo") in a mixed evergreen oak-wood of *Q. faginea-Q. ilex* subsp. *ballota* forest, with *Cistus* bushes, on acid gravel-bed, sandy soil, leg. F. J. REJOS & F. ESTEVE-RAVENTÓS, AH 30895 (Holotypus), WU 27866 (Isotypus).

Material studied: type collection.

Additional material studied: *Pholiotina aeruginosa* and *P. aeruginosa* var. *caeruleopallida*: see HAUSKNECHT (2007).

Characters (based on one single specimen):

Pileus: 2 cm in diam., at first convex, finally plane convex, not or hardly umbonate; margin not striate when humid, without rests of veil; surface smooth, dull, slightly lubricous when wet, hygrophanous, uniformly dark blue-green, hardly changing when drying.

Stipe: 7 × 0.2 cm, cylindrical, broadening at extreme base (-0.35 cm), slender, fistulose, whitish to cream, not darkening from base upwards, showing a slight glaucous reflection when drying; base with a patch of strigose hyphae; surface distinctly pruinose in upper half, fibrillose-pruinose towards base; veil not seen.

Lamellae: more or less crowded (L= 25-30), slightly ventricose, ascendant, narrow, at first yellowish-ochraceous, becoming orange-brown; lamellar edge minutely fimbriate, paler.

Context: whitish; smell weak, taste not recorded.

Basidiospores: 9-13 × 5-7 µm, ellipsoid-subamygdaliform, typically amygdaliform in side view, sometimes with subpapillate apex, smooth, yellow-orange in ammonia solution, with distinct apical germ-pore (1-1.2 µm wide), moderately thick-walled.

Basidia: 2-spored, clavate, 22-30 × 7-10 µm, with long sterigmata -7 µm.

Clamp connections: present.

Cheilocystidia: numerous, rendering the lamellar edge heterogeneous, 25-60 × 6.5-12 µm, sublageniform, with distinct sinuose neck, with obtuse non capitate apex.

Caulocystidia: numerous, similar to cheilocystidia, usually somewhat longer (-90 × 10 µm).

Pileipellis: a hymeniderm made up of clavate cells, 28-45 × 11-20 µm, with parietal dark blue-green pigment.

Comments: In spite of the only collection and the single specimen, the distinct morphological and ecological characters of this taxon may allow us to propose it as a new species. Obviously, its similarities to *P. aeruginosa* seem to be clear, but macro- and microscopical, and also ecological differences can be observed. First, the pileus colour fades with age in *P. aeruginosa*, turning paler with age, and even becoming brownish to ochraceous at margin; we have not observed a striate pileus margin in our specimen, even though this was found in humid condition. Definitely, *P. atrocyanea* shows darker blue-green colours, more uniform and not fading over the pileus surface (also noticed in exsiccate). Microscopically, the main differences are found in the 2-spored basidia of the new taxon, which release amygdaliform spores, often with a subpapillate apex. Ecologically, *P. aeruginosa* seems to be a species bound to humid de-

ciduous woods of Euro-Siberian character, whereas *P. atrocyanea* has been found in a Mediterranean *Quercus faginea* ("quejigo") forest, among mosses in sandy, acid soil. It could possibly be a species with Mediterranean character, but, as it is usual in blue-green species of *Pholiotina*, they are very rare, fruiting mostly solitary or in low number of specimens per collection, which makes it even more difficult to study them and to understand their variability.

The recently described *Pholiotina aeruginosa* var. *caeruleopallida* (HAUSKNECHT 2007) has even paler, hardly blue-green, more greenish-grey to bluish-grey colours of the pileus and 4-spored basidia like *P. aeruginosa*. Furthermore, it differs by thinner-walled spores with distinctly papillate germ-pore and has the same habitat as *P. aeruginosa* var. *aeruginosa*.

***Pholiotina sulcata* ARNOLDS & HAUSKN.** (Figs. 2 a-d, 3 b)
= *Conocybe plicatella* (PECK) KÜHNER ss. KÜHNER & auct. europ.
= *Galerella plicatella* ss. auct. europ.
= *Bolbitius luteolus* (LASCH) ss. RICKEN.

Material studied: Spain: Madrid, Navacerrada, La Barranca, 30TVL11, 21. 6. 1984, among grass in partly nitrified pastures on acid soil, leg. J. M. BARRASA & F. ESTEVE-RAVENTÓS, AH 9342; - Segovia, Fresno de Cantespino, 30TVL58, 5. 11. 2004, among grass in xerophytic and partly nitrified pastures, on acid soil, leg. J. M. BARRASA & F. ESTEVE-RAVENTÓS, AH 30968.

Characters:

Pileus: 0.5-2 cm in diam., at first campanulate to hemispherical, then convex to applanate-convex, not or hardly umbonate; margin striate when humid; surface smooth, dull, hygrophanous, orange-brown to amber-brown when humid, then orange-buff to ochraceous when dry, even buff to cream, with centre normally darker; margin typically sulcate to plicate with age, even radially split in some occasions, without visible rests of veil.

Stipe: 1.5-4 × 0.1-0.2 cm, cylindrical, slender, fistulose, sometimes with a small bulb with napiform aspect when young; surface whitish to cream-ochre, whitish pruinose-fibrillose all over.

Lamellae: moderately crowded, straight to subventricose, ascendant, narrow, adnexed, buff-ochraceous when young, brown-orange when mature; lamellar edge delicately fimbriate and somewhat paler.

Context: with a slight smell, sometimes reminiscent of *Pelargonium* leaves or absent; taste not recorded.

Basidiospores: 7.5-10 × 4.5-6 µm, ellipsoid to subamygdaliform, occasionally slightly flattened, smooth, orange in ammonia solution, with small (approx. 1 µm wide) and central germ-pore, moderately thick-walled.

Basidia: 4-spored (sometimes mixed with some 2-spored to 1-spored basidia), shortly clavate to sphaeropedunculate, 17-23 × 8-10 µm.

Clamp connections: present.

Cheilocystidia: numerous, mixed with basidia (lamellar edge not sterile), (20-) 35-50(-65) × 6-10(-12) µm, sublageniform, ventricose at base, with long and sinuose neck (2-3.5 µm broad), sometimes subcapitate at apex.

Pileipellis: typically a hymeniderm, with encrusting and parietal orange pigment. Pileocystidia not seen.

Phenology and habitat: in spring or warm autums, gregarious or rarely solitary; heliophilous, in more or less nitrified open pastures, in acid to neutral soils.

Distribution: Europe, widespread but rarely recorded; in the Iberian Peninsula previously only known from Catalunya (MAIRE 1937) and Madrid (ESTEVE-RAVENTÓS 1988, i.e. AH 9342).

Comments: see ARNOLDS & HAUSKNECHT (2003) and ARNOLDS (2005). It is easy to recognise by the typical radially sulcate-plicate pileus margin in well-developed specimens.

A variety from alpine to subalpine habitats, var. *oreina* HAUSKN., has been recently described (HAUSKNECHT 2007). It differs not only by the habitat, but also by larger, darker spores with thicker walls and is known up to now only from the Alps in Austria and Switzerland.

***Pholiotina velata* (VELEN.) HAUSKN.** (Figs. 2 e-h, 3 c)
≡ *Galera velata* VELEN.
= *Pholiotina appendiculata* (WATLING) SINGER; = *Conocybe appendiculata* WATLING; = *Conocybe appendiculata* J. E. LANGE & KÜHNER, inval.

Material studied: Spain: Cataluña, San Marti de Montenegre, 30. 10. 1985, leg. D. A. REID (K); - Huesca, Panticosa, Balneario de Panticosa, 30TYN2638, 1650 m s. m., 16. 8. 1996, in humose soil under *Fraxinus excelsior* L. and *Acer* spec. in human-nitrified park along a roadside, on acid (cf.) soil, leg. F. ARENAL, F. ESTEVE-RAVENTÓS & V. GONZÁLEZ, AH 21579.

Characters:

Pileus: 1-2.5 cm in diam., at first campanulate to convex, finally plane convex, not or hardly umbonate; margin striate when humid, with appendiculate and more or less fugacious rests of whitish veil, visible only in young specimens; surface smooth, dull, hygrophanous, orange-brown to amber when humid, becoming orange-ochraceous to buff or cream-ochraceous when dry, with disc always darker in most cases.

Stipe: 2-5 × 0.15-0.3 cm, cylindrical, slender, fistulose, whitish to cream, sometimes with a silvery reflection, becoming darker and brown from base upwards; surface minutely floccose at apex, fibrillose downwards; membranous whitish veil sometimes visible in small and fugacious patches along the stipe, but never forming a ring.

Lamellae: more or less crowded, subventricose to straight, ascendant, narrow, pale cream at first, becoming ochraceous-brown; lamellar edge minutely fimbriate, whitish or paler.

Context: brownish or darker at stipe base; taste and smell weak or sometimes reminiscent of *Pelargonium* leaves.

Basidiospores: 7-8.5 × 4-5 µm, ellipsoid to oblong, sometimes subamygdaliform in side view, smooth, orange in ammonia solution, with small, central germ-pore and moderately thick-walled.

Basidia: 4-spored, clavate, 20-25 × 7-8 µm.

Clamp connections: present.

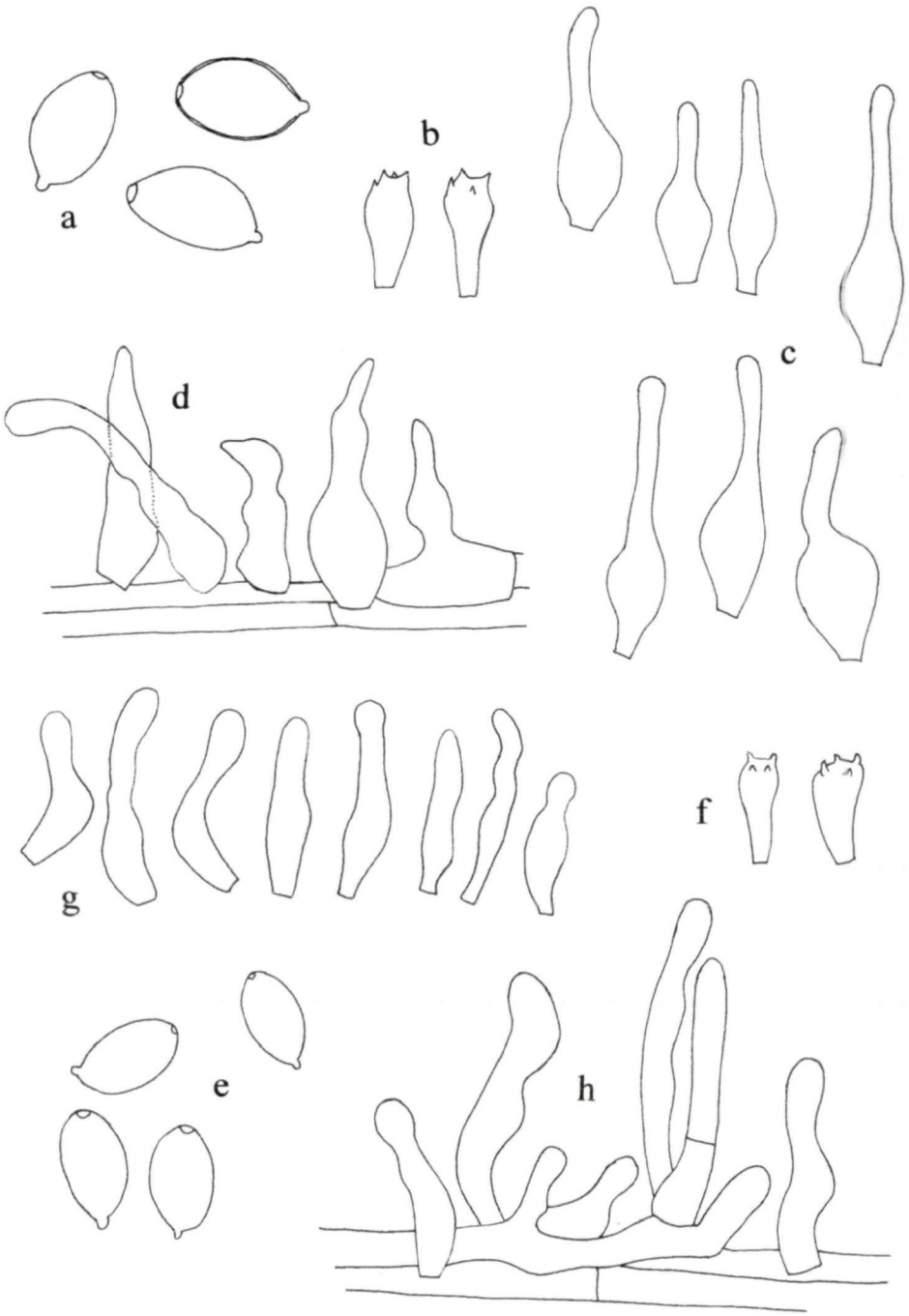

Fig. 2 *a-d. Pholiotina sulcata* (AH 30968). *a* spores, × 2000, *b* basidia, × 800, *c* cheilocystidia, × 800, *d* caulocystidia, × 800. *e-h. Pholiotina velata* (AH 21579). *e* spores, × 2000, *f* basidia, × 800, *g* cheilocystidia, × 800, *h* caulocystidia, × 800.

Cheilocystidia: numerous, 25-55 × 5-12 µm, (sub)-lageniform to subcylindrical, with sinuose neck (4-6 µm wide), sometimes with subcapitate apex.

Pileipellis: a hymeniderm, with encrusting to parietal brown-orange pigment. Pileocystidia absent.

Phenology and habitat: solitary to gregarious from spring to autumn, in humid and rich humose, normally clayey, soils; under various deciduous trees, near deciduous woods, parks, gardens, roadsides, exceptionally in burned soils.

Distribution: in Europe widespread, but often confused with other taxa; two collections known from the Iberian Peninsula: The first record in Spain was detected by the second author in the herbarium K, made by D. A. REID in Cataluña, San Marti de Montenegre, 30. 10. 1985; the second specimen from Huesca (ESTEVE-RAVENTÓS & al. 1997) is illustrated in Figs. 2 e-h and 3 c.

MALENÇON (MALENÇON & BERTAULT 1970-1975) collected the species also in Morocco, and the second author studied one collection from Asia (Georgia).

Comments: see WATLING (1971, as *Conocybe appendiculata*), HAUSKNECHT (1999), ENDERLE (2000), and ARNOLDS (2005). Diagnostic characters for this species are the appendiculate pileus margin (in young specimens), stipe browning from the base, small basidiospores with central germ-pore and lageniform cheilocystidia.

Pholiotina nemoralis (HARMAJA) BON var. *nemoralis* and var. *dentatomarginata* (WATLING) HAUSKN. (see HAUSKNECHT 2007) = *Conocybe appendiculata* forma *macrospora* KÜHNER, differ by much longer basidiospores (9-11 × 5-5.5 µm), whereas *P. exannulata* (KÜHNER & WATLING) COURTEC., has darker colours and wider, more variable, often utriform cheilocystidia.

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References

ARNOLDS, E., 2005: Genus *Pholiotina*. – In NOORDELOOS, M. E., KUYPER, T. W., VELLINGA, E., (Eds): Flora Agaricina Neerlandica **6**: 180-203. – Boca Raton, London, New York, Singapore: Taylor & Francis.

— HAUSKNECHT, A., 2003: Notulae ad Floram Agaricinam Neerlandicam – XLI. *Conocybe* and *Pholiotina*. – Persoonia **18**: 239-252.

DANIËLS, P. P., MORENO-ARROYO, B., 2006: Contribución al estudio de la diversidad fúngica andaluza. – Bol. Soc. Micol. Madrid **30**: 271-279.

ENDERLE, M., 1991: *Conocybe-Pholiotina* Studien II: Beschreibung einiger Funde. – Z. Mykol. **57**: 75-108.

— 2000: *Conocybe-Pholiotina* Studien X. – Micologia 2000: 165-176. – Vicenza: Centro Studi Micologici dell'A.M.B.

ESTEVE-RAVENTÓS, F., 1988: Algunas especies raras e interesantes del género *Conocybe* s.l. recogidas en la zona centro peninsular. – Bol. Soc. Micol. Madrid **12**: 57-65.

— GONZÁLEZ GARCÍA, V., ARENAL YAGÜE, F., 1997: Catálogo micológico de los macromicetos de áreas alpinas y subalpinas del Parque Nacional de Ordesa y zonas limítrofes (Huesca. España) recogidos en 1996. – Bol. Soc. Micol. Madrid **22**: 155-186.

HAUSKNECHT, A., 1999: Revision von VELENOVSKY's *Galera*-Arten, die den Gattungen *Conocybe* und *Pholiotina* angehören. – Czech Mycol. **51**: 41-70.

— 2007: Beiträge zur Kenntnis der *Bolbitiaceae* 11. Unberingte Arten der Gattung *Pholiotina*. – Österr. Z. Pilzk. **16**: 35-116.

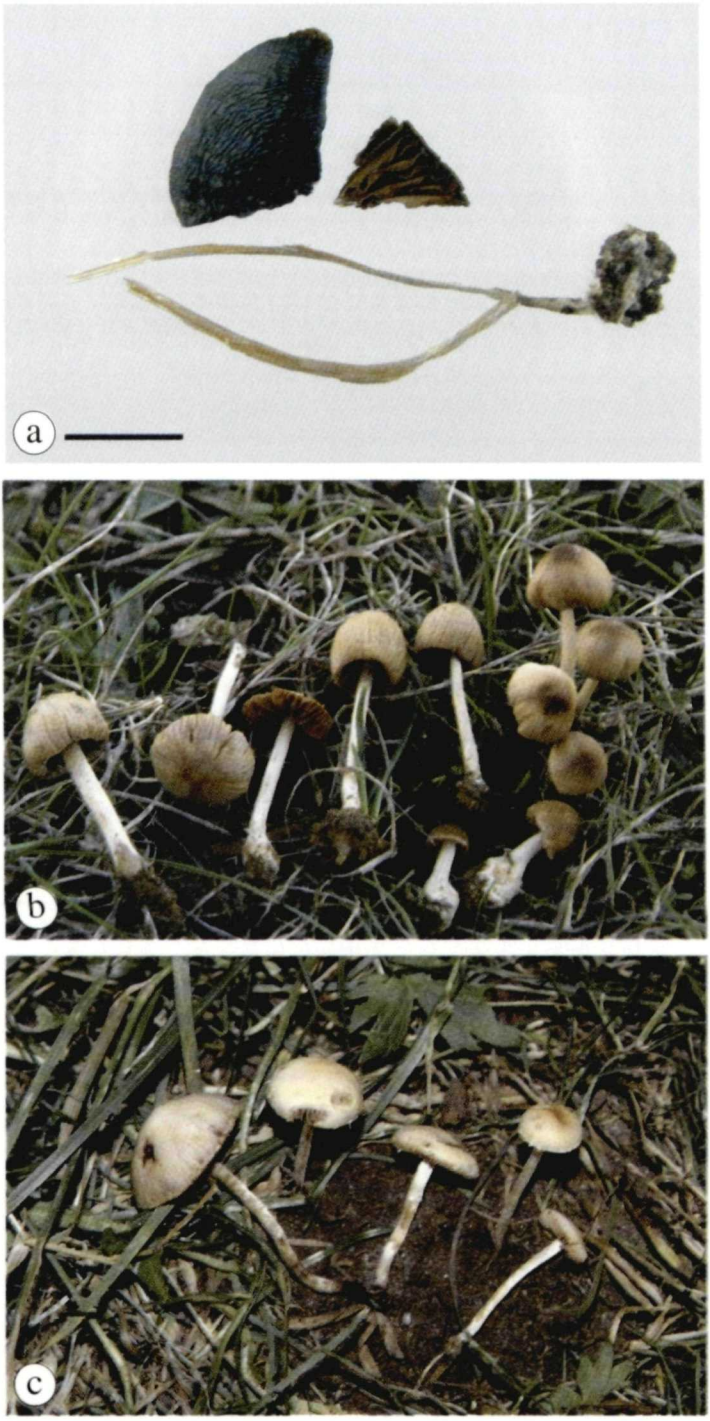

Fig. 3. *a Pholiotina atrocyanea* (exsiccatum, holotype). *b Pholiotina sulcata* (AH 30968). *c Pholiotina velata* (AH 21589). – Phot. F. ESTEVE-RAVENTÓS.

LONATI, G., 1993: Funghi rari o poco conosciuti: *Pholiotina aporos* e *Pholiotina brunnea*. – Micol. Veget. Medit. **8**: 9-14.

MAIRE, R., 1937: Fungi Catalaunici. Series altera. Contribution à l'étude de la Flore Mycologique de la Catalogne. – Publ. Inst. Bot. Barcelona **3(4)**: 1-128.

MALENÇON, G., BERTAULT, R., 1970-1975: Flore des champignons supérieurs du Maroc 1, 2. – Rabat: Faculté des Sciences.

ROCABRUNA, A., 1999: *Pholiotina aporos* (KITS VAN WAV.) CLÉMENÇON. – Bolets de Catalunya **18**: 883. – Barcelona: Societat Catalana de Micologia.

WATLING, R., 1971: The genus *Conocybe* subgenus *Pholiotina* II. Some European exannulate species and North American annulate species. – Persoonia **6**: 313-339.

— 1982: *Bolbitiaceae*: *Agrocybe*, *Bolbitius* & *Conocybe*. – In HENDERSON, D. M., ORTON, P. D., WATLING, R., (Eds): British Fungus Flora. Agarics and Boleti 3. – Edinburgh: Her Majesty's Stationery Office.