CZECH MYCOLOGY 65(1): 45–67, JUNE 10, 2013 (ONLINE VERSION, ISSN 1805-1421)

Rare macromycetes from raised bogs in the Hrubý Jeseník Mts. (Czech Republic)

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Vašutová M., Dvořák D., Beran M. (2013): Rare macromycetes from raised bogs in the Hrubý Jeseník Mts. (Czech Republic). – Czech Mycol. 65(1): 45–67.

During a mycobiota study of raised bogs in the Hrubý Jeseník Mts., the rare fungi *Omphaliaster borealis*, *Galerina sphagnicola*, *Clavaria argillacea* var. *sphagnicola*, *Ramariopsis subarctica* and *Ascocoryne turficola* were found. Descriptions and figures of microscopic characters, photos and a summary of the knowledge on the ecology and distribution of these species in Europe, and a brief comparison with similar species are given. The boreo-alpine species *Omphaliaster borealis* is reported from the Czech Republic for the first time. It can be confused with *Arrhenia onisca* in the field. Another species new to the Czech Republic, the strictly sphagnicolous *Galerina sphagnicola*, can be overlooked and confused with several other sphagnicolous *Galerina* species. The newly reported variety of *Clavaria argillacea*, var. *sphagnicola*, is distinguished from the nominate variety by shape and size of its spores, as well as its habit and ecology. *Ramariopsis subarctica* was known in the Czech Republic so far only from the Giant Mts. (Krkonoše). Within Europe, the two Czech localities, along with a find in the High Tatra Mts. (Slovakia), are the only ones known outside Fennoscandia. *Ascocoryne turficola* is reported from Moravia for the first time.

Key words: macrofungi, peatland, raised bog, distribution.

Vašutová M., Dvořák D., Beran M. (2013): Vzácné makromycety rašelinišť Hrubého Jeseníku. – Czech Mycol. 65(1): 45–67.

V rámci studia mykoflóry rašelinišť v Hrubém Jeseníku byly nalezeny vzácné druhy hub *Omphaliaster borealis*, *Galerina sphagnicola*, *Clavaria argillacea* var. *sphagnicola*, *Ramariopsis subarctica* a *Ascocoryne turficola*. Jsou publikovány popisy nálezů a nákresy mikroznaků, fotografie, shrnutí dosavadních znalostí o ekologii a rozšíření v Evropě a stručné srovnání s podobnými druhy. Druh s borealně alpínským rozšířením *Omphaliaster borealis* nebyl dosud v ČR nalezen, v terénu může být zaměňován za *Arrhenia onisca*. Další druh nový pro ČR – striktně rašeliništní *Galerina sphagnicola* – může být přehlížen a zaměňován za ostatní sphagnikolní druhy rodu *Galerina*. *Clavaria argillacea* var. *sphagnicola* dosud nebyla z ČR publikována; od nominátní variety se liší tvarem a velikostí výtrusů, vzhledem plodnic a ekologií. *Ramariopsis subarctica* byl dosud znám v ČR jen z Krkonoš, spolu s nálezy z Hrubého Jeseníku a Vysokých Tater jde o jediné evropské lokality mimo Skandinávii. *Ascocoryne turficola* je poprvé publikována z Moravy.

INTRODUCTION

Raised bogs are valuable peatland ecosystems occurring mainly in mountain areas with high precipitation and low temperatures. They are poor in plant species, formed mainly by *Sphagnum*, and dependent on rainfall for their water and nutrients (Hájek & Rybníček 2010). The Hrubý Jeseník Mts., designated a Protected Landscape Area, are located in the eastern part of the Sudetes Mountains in the NE part of the Czech Republic and are the second highest mountain range in the Czech Republic (and one of three reaching the alpine belt). Typical raised bogs are confined here mostly to either plateaus on summit, mountain saddles and gentle slopes at altitudes of about 1300 m. These habitats, due to their remote location, have only slightly been affected by direct human activities and are therefore well-preserved, in contrast to some transient-bogs or raised bogs in lower elevations of the Hrubý Jeseník Mts., which have often been disturbed or almost destroyed by drainage in the past (e.g. drainage attempts in Rejvíz pine bog, see Dudová et al. 2010). Thus, they supposedly harbour rare or endangered fungal species.

Data on the mycobiota of raised bogs in the Czech Republic (or former Czechoslovakia) were summarised by Pilát (1969). Later, several mycological studies of raised bogs have been published (Šumava Mts.: Jezerní slať, Mrtvý luh – Holec 1997, 2000; Krkonoše Mts.: Pančická louka, Úpská rašelina – Fellner 1989; Krušné hory Mts.: Novodomské rašeliniště, Mrtvý rybník, Velké jeřábí jezero, Božídarské rašeliniště – Šteklová 1979, Uhliarová & Lepšová 1999). However, in the Hrubý Jeseník Mts., the region we are interested in, no information on fungi in raised bogs has been published, except for reports on particular localities at lower altitudes (e.g. Veselský 1966, Diener & Veselský 1969).

Under the project "Past and present changes in mountain mires of the Sudetes", we monitored seven raised bogs in the Hrubý Jeseník Mts. during 2008–2011 to study their fungal species diversity (Hájek et al., in prep.).

Here we present records of three taxa new to the Czech Republic and two other very rare species, both associated with raised bogs in Central Europe.

MATERIAL AND METHODS

A b b r e v i a t i o n s. NNR – National Nature Reserve, NR – Nature Reserve, not. = species only noted, without collecting a herbarium specimen (see Kotlaba 1999).

S t u d i e d s i t e s. The studied raised bogs are located on the main ridge of the Hrubý Jeseník Mts., not far from the upper tree line (Fig. 8; timber line according to Treml & Banaš 2000, 2005). Brief characteristics of these localities are given below. Geographical coordinates relate to the centre of each locality; sizes of the

localities (including surrounding peat spruce forest) and maximum humolite depth are after Rybníček (1997). Water pH standardised at 20 °C was measured using a HACH 240q multimeter. The pH value for each site is given separately for lawns/hummocks, and hollows/pools as an average based on measurement three times per year (May, July, September) during the years 2008–2011.

Site Vozka – Šerák-Keprník NNR, 0.65 km N of the summit of Mt. Vozka (1377 m), coord. 50°09'32" N, 17°06'25" E, alt. 1325 m, size 8 ha, depth 180 cm, pH = 4.20/4.30. Largest of the observed bogs, with well-developed pools and with broad marginal zone covered by bog spruce forest.

Site Trojmezí I – Šerák-Keprník NNR, 0.85 km S of the summit of Mt. Keprník (1423 m), coord. 50°09'51" N, 17°06'55" E, alt. 1320 m, size 0.7 ha, depth 145 cm, pH = 4.17/4.38.

Site Trojmezí II – on ridge SE of Mt. Keprník (1423 m), 1.1 km S of the summit, coord. 50°09'41" N, 17°07'05" E, alt. 1300 m, size 0.5 ha, depth 140 cm, pH = 4.83/4.59.

Site Barborka – Praděd NNR, in the saddle between Mts. Praděd and Petrovy kameny, 0.9 km S of the summit of Praděd (1491 m), coord. 50°04'29" N, 17°13'44" E, alt. 1315 m, size 0.5 ha, depth 90 cm, pH = 4.03/4.18.

The studied sites are typical raised bogs located in mountain saddles. Their forestless parts are small (usually not exceeding 1 ha) with poor and rather homogeneous vegetation. Lawns and hummocks (plant association *Andromedo polifoliae-Sphagnetum magellanici*) are formed by the peat mosses *Sphagnum angustifolium*, *S. fallax*, *S. magellanicum* and *S. russowii*, with just a few species of graminoid vascular plants (*Eriophorum vaginatum*, *Carex pauciflora)* and ericoid dwarf shrubs (*Andromeda polifolia*, *Calluna vulgaris*, *Empetrum hermaphroditum*, *Oxycoccus palustris* and *Vaccinium uliginosum*). *Carex limosa* and *Warnstorfia fluitans* dominate in some hollows and pools (*Drepanoclado fluitantis-Caricetum limosae* ass.), while others are free of plant and moss species. At margins, bogs fluently pass into the surrounding peat spruce forests (Rybníček 1997; terminology follows Hájek & Rybníček 2010).

The mycobiota of studied raised bogs is composed mainly of the sphagnicolous species *Hypholoma elongatum* (Pers.) Ricken, *Galerina paludosa* (Fr.) Kühner, *G. hybrida* Kühner, and *Lyophyllum palustre* (Peck) Singer, which usually produce a high number of fruitbodies. Other sphagnicolous species, e.g. *Arrhenia gerardiana* (Peck) Elborne and *A. onisca* (Fr.: Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys, were less frequently collected. *Nimbomollisia eriophori* (L.A. Kirchn.) Nannf. and *Mollisia palustris* (Roberge ex Desm.) P. Karst. are the most frequent species on graminoid plants. At margins and in places where the water level is deeper below the soil surface and small trees of *Picea abies* grow, some ectomycorrhizal (especially *Cortinarius* species) and lignicolous species were noticed.

Methods. Descriptions are based on collections from the Hrubý Jeseník Mts. Macromorphological characters of fungi were observed on fresh fruitbodies. Description of microscopic characters is based on dried material mounted in ammoniacal Congo-red (Basidiomycota), Melzer reagent or 3% KOH (*Ascocoryne*) using an Olympus CX40 microscope. Drawings of microcharacters were made with a drawing tube. At least 20 randomly selected mature spores, 10 randomly selected cheilocystidia and 10 basidia or 10 randomly selected asci were measured in each of three representative specimens (if available) of each species. Spores were measured without ornamentation. The size of each microscopic structure is given as the 10- and 90-percentiles of all measurements, whereby the 5- and 95-percentiles are given in brackets. Q represents the length-width ratio.

All herbarium specimens listed under "Collections studied" were microscopically examined; any deviations recorded have been included in the descriptions of the species. Description terminology is taken from Vellinga (1988). Abbreviations of public herbaria follow Thiers (on-line). Specimens are deposited in BRNM, CB and BRNU.

RESULTS AND DISCUSSION

Omphaliaster borealis (M. Lange & Skifte) Lamoure Figs. 1, 2, 9

≡ *Hygroaster borealis* (M. Lange & Skifte) M.M. Moser

Description. Fruitbodies rather fleshy, growing solitary, in groups or even fasciculate. Pileus up to 30 mm, at first more or less applanate, then umbilicate, with inrolled, at maturity deflexed margin, weakly translucently striate when wet, smooth, dark bistre to dark grey, distinctly hygrophanous, beige-greyish when dry. Lamellae arcuate, shortly decurrent to almost adnate, later distinctly decurrent, moderately distant to distant, pale grey, often with darker edge in mature fruitbodies. Stipe rather stout, up to 35 × 4 mm, cylindrical, often attenuated at base, hollow, smooth, finely longitudinally fibrillose or even slightly striate, concolorous with pileus, with white tomentum at base. Context greyish, with faint farinaceous smell and distinctly farinaceous taste. Spores 4.5–6 × 4–5 µm, Q = 1.0–1.3, globose to broadly ellipsoid with up to 2 µm long spines, approximately (4)5–6(7) spines visible along circumference. Basidia (32)34–52(58) × (6)6.5–9 µm, 4-spored, rarely 2-spored. Cystidia absent. Pseudocystidia scattered, 21–32 × 5–6 µm, slender, narrowly fusoid to narrowly utriform. Caulocystidia rare, poorly differentiated, cylindrical, looking like ends of hyphae, 53–75 × 5–6 µm. Lamellar trama subregular. Clamps absent. Pileipellis a cutis composed of interwoven hyphae, more or less incrusted, terminal parts mostly not incrusted, some hyphae with dark coloured content (necropigment?).

Fig. 1. *Omphaliaster borealis*, Šerák-Keprník NNR, 3 Oct. 2012, leg. D. Dvořák (BRNU 626510). Photo D. Dvořák.

Fig. 2. Comparison of *Arrhenia onisca* (left) and *Omphaliaster borealis* (right), Šerák-Keprník NNR, 3 Oct. 2012, leg. D. Dvořák (BRNU 626509, BRNU 626510). Photo D. Dvořák.

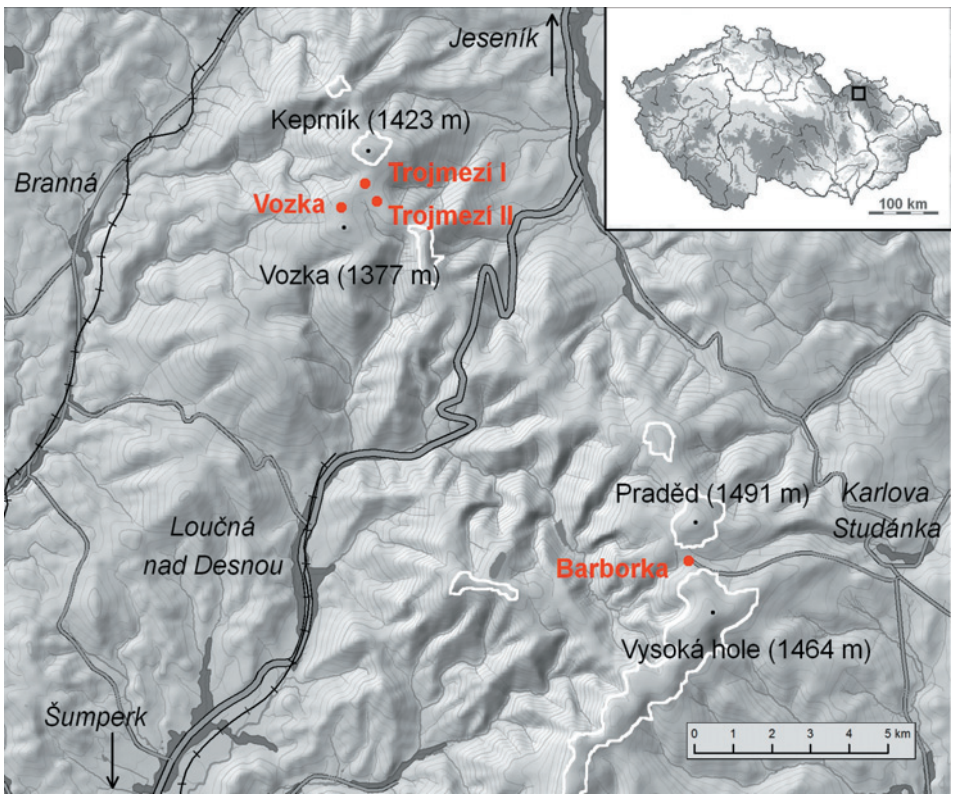
Fig. 3. *Galerina sphagnicola*, Praděd NNR – Barborka, 12 Sept. 2011, leg. D. Dvořák (BRNM 747290). Photo D. Dvořák.

Fig. 4. *Clavaria argillacea* var. *sphagnicola*, Šerák-Keprník NNR, 6 Sept. 2010, leg. M. Vašutová (BRNM 747281). Photo M. Kříž.

Fig. 5. *Ramariopsis subarctica*, Šerák-Keprník NNR, 3 Oct. 2012, leg. D. Dvořák (BRNU 626511). Photo D. Dvořák.

Fig. 6. *Ramariopsis subarctica*, Šerák-Keprník NNR, 3 Oct. 2012, leg. D. Dvořák (BRNU 626511). Photo D. Dvořák.

Fig. 7. *Ascocoryne turficola*, Šerák-Kepmík NNR, 6 Sept. 2010, leg. M. Kříž (BRNM 747287). Photo M. Kříž.



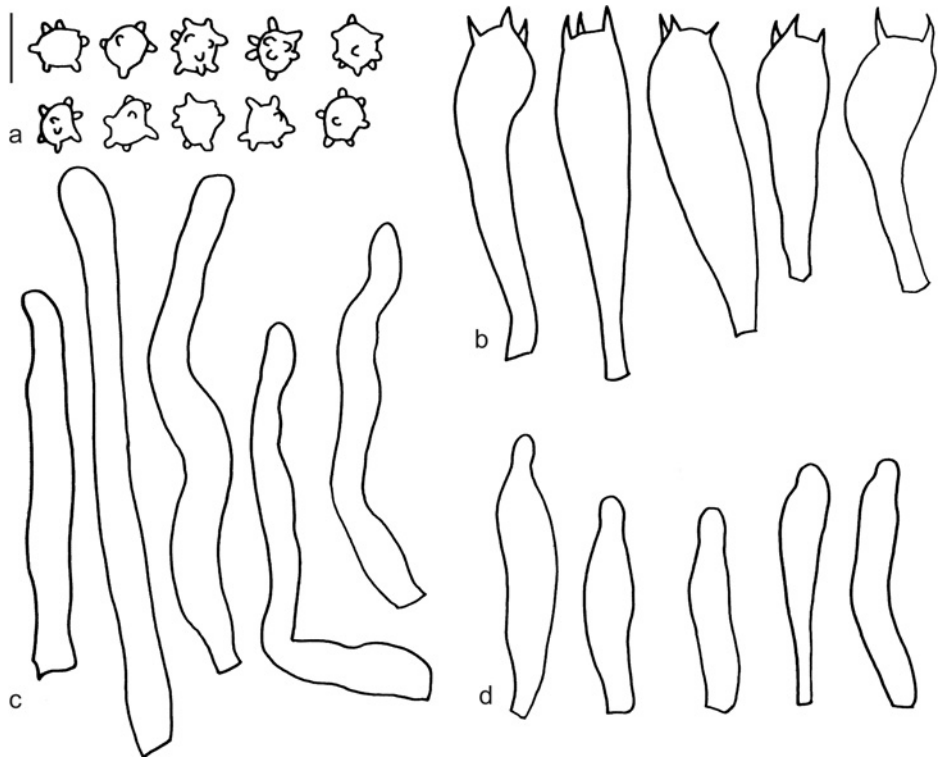


Fig. 9. *Omphaliaster borealis* (BRNM 747284 – a, d; BRNU 626510 – b, c): **a** – spores, **b** – basidia, **c** – caulocystidia, **d** – pseudocystidia. Bar = 10 µm. Del. M. Vašutová.

Collection studied

Czech Republic. Hrubý Jeseník Mts., site Vozka, *Andromedo polifoliae-Sphagnetum magellanici*, among *Sphagnum fuscum*, 31 May 2009, leg. D. Dvořák (BRNM 747284); ibid., among *Sphagnum russowii*, *S. fallax*, *S. angustifolium*, *Oxycoccus palustris*, *Calluna vulgaris*, etc., 3 Oct. 2012, leg. D. Dvořák (BRNU 626510).

Distribution in the Czech Republic. The species had not been reported before. We supposed that it could have been superficially misidentified by collectors as one of the sphagnicolous omphalinoid *Arrhenia* species [*A. onisca*, *A. gerardiana*, *A. philonotis* (Lasch) Redhead, Lutzoni, Moncalvo & Vilgalys] before, nevertheless, the revision of specimens of these taxa in selected Czech herbaria (PRM, BRNM, CB, HR) did not reveal any other record of *Omphaliaster borealis*.

◀ **Fig. 8.** Map of studied raised bogs in the Hrubý Jeseník Mts.

Red dots represent localities studied, the white line is the approximate upper timberline (redrawn from Treml & Banaš 2005). Dominant mountain tops of the ridge are highlighted in black, the nearest villages or towns are given in italics. Contour interval 50 m. The location of the studied area within the Czech Republic is shown in the inserted map.

Distribution in Europe. Widespread in northern part of Fennoscandia (Norway, Sweden, Finland; Knudsen 2012), several records in the mountains of Great Britain [Scotland, Wales; Kirk & Cooper (on-line)], very rare in Central Europe – Germany (Bayern – Einhellinger 1977, Karasch & Hahn 2009; Baden-Württemberg – Winterhoff & Krieglsteiner 1984, Gminder & Krieglsteiner 2001), single records from Austria (Rücker & Peer 1988, Dämon et al. 2009) and Switzerland (Roemer 2004).

Selected descriptions. Bresinsky (2008: 34–35), Einhellinger (1977: 86), Knudsen (2012: 263), Lamoure (1971: 278–279), Lange & Skifte (1967: 46–49).

Selected illustrations. Winterhoff & Krieglsteiner (1984: p. 90, fig. 10), Moser & Jülich (1985–2003: *Omphaliaster* I), Bresinsky (2008: fig. 4).

Notes. Besides the Czech Republic, *Omphaliaster borealis* has been found in raised bogs also at several German localities in the foothills of the Alps (Einhellinger 1977, Gminder & Krieglsteiner 2001), and in northern Europe (Lamoure 1971, Knudsen 2012). The species, however, is apparently not bound to *Sphagnum*, since it occurs also in alpine heaths (together with e.g. *Loiseleuria procumbens*, *Empetrum* sp., *Juncus trifidus*; Lange & Skifte 1967, Roemer 2004, Dämon et al. 2009). According to Lamoure (1971) and Gulden (2005), it grows also in snowbed vegetation with *Salix herbacea* and is acidophilous. In contrast to the latter habitats, in raised bogs *O. borealis* seems to fructify also in spring (BRNM 747284, Einhellinger 1977, 1982).

Our material agrees very well with published descriptions and photographs, except for some authors describing an indistinct or lacking smell (Lamoure 1971, Kuyper 1995), taste (Knudsen 2012), or both (Gulden 2005). Lange & Skifte (1967) measured spores with ornamentation; therefore their values are conspicuously higher. The closely related *Omphaliaster asterosporus* (J.E. Lange) Lamoure has more slender fruitbodies [but Šutara (1987) presents a collection having robust fruitbodies with pileus up to 35 mm in diam.] with a paler, strongly hygrophanous and more prominently translucently striate pileus. According to our microscopic observations (CB 15851, CB 6057, BRNU 626513), *O. asterosporus* differs by slightly larger spores [5.5–6(7) × 5–5.5 µm, Q = 1–1.3] and more spines visible along the circumference (approximately 8–9 spines; Fig. 10). A similar spore size difference is reported by Knudsen (2012), however Ludwig (2012) measured bigger spores in *O. borealis*. The lower density of spines in *O. borealis* is in accordance with our observation. Besides morphological features, *O. asterosporus* also has a different ecology – it grows among various mosses mainly in coniferous forests and we do not know of any records from raised bogs.

In the field, the rather similar species *Arrhenia onisca*, growing in similar habitats (and co-occurring with our collection of *O. borealis)*, differs by more slender, thin-fleshed fruitbodies, more decurrent lamellae, a pileus markedly translucently striate almost to the centre, absence of white tomentum at stipe base (Fig. 2), a weak smell and taste, and smooth spores.

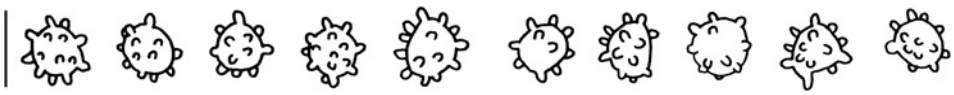


Fig. 10. *Omphaliaster asterosporus* (CB 15851): spores. Bar = 10 µm. Del. M. Vašutová.

Galerina sphagnicola (G.F. Atk.) A.H. Sm. & Singer Figs. 3, 11

Description. Pileus up to 15 mm broad, paraboloid with broad umbo, later convex, hygrophanous, brownish ochre, paler at margin, translucently striate (up to 2/3 of radius), surface smooth, in young fruitbodies with slightly developed veil at margin. Lamellae moderately crowded, adnate, brownish ochre (darker than the macroscopically similar *G. hybrida*), edge paler, finely fimbriate. Stipe up to 60 × 2 mm, brownish ochre to yellowish ochre, with indistinct white veil remains in upper part. Smell and taste indistinct. Spores 10–11.5(12) × 5.5–6.5 µm, Q = 1.7–1.9, amygdaliform in side view, with weak to distinct suprahilar depression, ovoid in face view, rounded at base, with conically attenuated top and small hilar appendix, smooth; ca. 1/2 of the spores distinctly calyptrate, yellow-brown in water, dextrinoid. Basidia 25–29 × 7–8 µm, 4-spored. Cheilocystidia 34–42 × 7–10 µm, densely packed, thin-walled, very variable, lageniform to utriform, mostly with enlarged apex, sometimes irregularly constricted. Pleurocystidia absent. Caulocystidia present in upper part of stipe, 38–65 × 7–9 µm, utriform to narrowly clavate, sometimes flexuose. Lamellar trama subregular, hyphae colourless, rarely refringent. Clamps present. Pileipellis a cutis, in some places covered with veil fibrils.

Collection studied

Czech Republic. Hrubý Jeseník Mts., site Barborka, *Andromedo polifoliae-Sphagnetum magellanici*, among *Sphagnum russowii* and *S. angustifolium*, 6 Sept. 2010, leg. M. Vašutová (BRNM 747289); ibid., among *Sphagnum fallax*, *S. russowii*, 12 Sept. 2011, leg. D. Dvořák (BRNM 747290).

Distribution in the Czech Republic. The species had not been reported yet.

Distribution in Europe. Northern Europe – S Sweden, S Finland, Norway (Gulden 2012), Belgium – Limburg (de Haan & Walleyn 2009), Slovakia – Starý Smokovec (Roux 2006), Great Britain (Kirk & Cooper on-line), Austria (Keller & Moser 2001).

Selected descriptions. Roux (2006: 704), de Haan & Walleyn (2009: 11–13).

Selected illustrations. Roux (2006: p. 704), de Haan & Walleyn (2009: fig. 3).

Notes. *G. sphagnicola* is a strictly sphagnicolous species, growing in bogs in autumn (Smith & Singer 1964, Roux 2006, de Haan & Walleyn 2009, Gulden 2012). A more specific relation to *Sphagnum* species or plant communities has not been evaluated because detailed descriptions of its habitat is mostly missing from the literature.

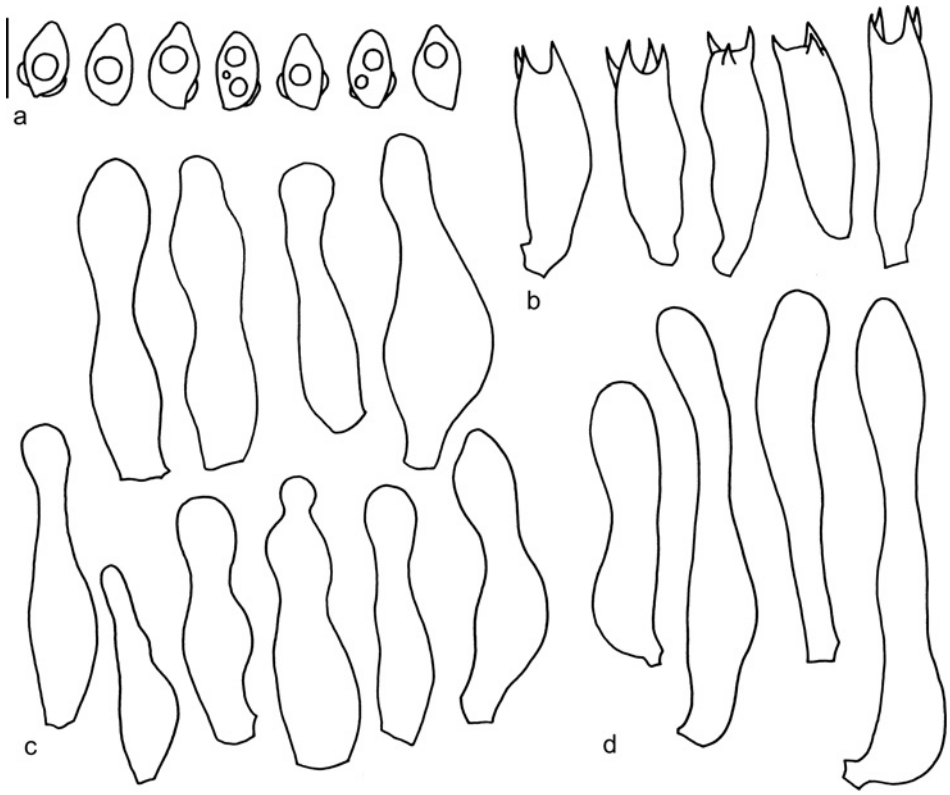


Fig. 11. *Galerina sphagnicola* (BRNM 747290): **a** – spores, **b** – basidia, **c** – cheilocystidia, **d** – caulocystidia. Bar = 10 µm. Del. M. Vašutová.

Macroscopically it reminds *Galerina hybrida* or *G. sphagnorum*, but *G. hybrida* is often more robust and *G. sphagnorum* usually has an olive tinge. Roux (2006) emphasises the umbonate pileus with a slightly velate margin and absence of a farinaceous smell as distinctive macroscopic characters of *G. sphagnicola*. Important microscopic characters of *G. sphagnicola* are the smooth, calyptrate spores and cheilocystidia that are remarkably variable in shape. Whereas our specimen has clearly amygdaliform spores, the description of the spore shape in *G. sphagnicola* varies in the literature: Smith & Singer (1964) – somewhat inequilateral in profile, broadly ovoid in face view and often with acute apex; Roux (2006) – ovoid-ellipsoid; Gulden (2012) – ellipsoid to broadly ovoid (although fig. 898D shows clearly amygdaliform spores); de Haan & Walleyn (2009) – subovoid to shortly amygdaliform in side view, ovoid in frontal view, with conical attenuated top. Because the spores of our collections fit well with the original description of Atkinson (1918), who states "sporis … ovalibus vel subnavicularibus,

ad basem crassioribus", we are convinced that our collection represents *G. sphagnicola*.

De Haan & Walleyn (2009) state that *G. sphagnicola* is possibly conspecific with *G. cerina* A.H. Sm. & Singer, which may occasionally also grow in *Sphagnum*. According to the identification key by Gulden (2012), the main difference between these two species is in the stature of the fruitbodies: *Galerina sphagnicola* has, similarly to most other sphagnicolous species, rather large fruitbodies having a stem of 50–100 × 1–3 mm and a pileus of up to 30 mm in diameter, whereas *G. cerina* is described as more slender – stem 5–50 × 0.5–1 mm, pileus up to 15 mm broad. We found collections intermediate between *G. cerina* and *G. sphagnicola* in *Sphagnum* at two other localities in the Hrubý Jeseník Mts. (Rejvíz NNR, Šerák-Keprník NNR). With regards to the above mentioned problems, their identification remains unresolved. According to Smith & Singer (1964), mixed collections of *G. sphagnorum* and *G. sphagnicola* are likely to occur due to macroscopic similarity. We have not met such mixed collections in the field yet.

Clavaria argillacea* var. *sphagnicola (Boud.) Corner Figs. 4, 12

≡ *Clavaria sphagnicola* Boud.

Description. Fruitbodies solitary or fasciculate, narrowly clavate, up to 70 mm tall. Fertile upper part more or less distinctly separated from the stem, up to 35 × 9 mm, often compressed, smooth, yellowish to pale yellow, sometimes with brownish tip when mature. Stem up to 35 × 2.5 mm, cylindrical, smooth, yellow, darker than the upper part. Spores (7)8–9.5(10) × 5–6 µm, Q = (1.4)1.5–1.8, ellipsoid to oval, smooth, colourless, hilar appendix indistinct. Basidia (50)52–63 × 7–9(9.5) µm, with loop-like clamps at base. At stipe surface, mostly in upper part, indistinct caulocystidia or protruding ends of hyphae occur, which are clavate to cylindrical, straight or flexuose, rarely branched, 3–4 µm broad, often in fascicles.

Collections studied

Czech Republic. Hrubý Jeseník Mts., site Trojmezí II, *Andromedo polifoliae-Sphagnetum magellanici*, among *Sphagnum russowii*, 15 Sept. 2008, leg. M. Beran (BRNM 747282); ibid., 6 Sept. 2010, leg. M. Vašutová (BRNM 747281); ibid., 12 Sept. 2011, leg. H. Deckerová et D. Dvořák (BRNM 747280); ibid., 29 Sept. 2011, among *Sphagnum* sp., leg. D. Dvořák (BRNU 626507). – Site Vozka, *Andromedo polifoliae-Sphagnetum magellanici*, among *Sphagnum russowii*, 15 Sept. 2008, leg. M. Beran (BRNM 747283); ibid., 12 Sept. 2011, leg. D. Dvořák (BRNU 626505). – Českomoravská vrchovina Mts., Mosty, 0.9 km SSE: W bank of Polom pond, transient peat bog called „Malá Zvůle", coord. 49°06'10" N, 15°14'24" E, alt. 620 m; among *Sphagnum* sp. and *Oxycoccus palustris*, 6 Oct. 2005, leg. P. Hesoun (CB 16303).

Poland. Woj. Malopolskie, Kościelisko-Biały Potok, ca. 0.5 km WSW of the village, alt. 910 m, transient peat bog, 2 Oct. 2004, leg. D. Dvořák (BRNU 626503). – Piekielnik, Puścizna Wielka, ca. 3–4 km S of the village, alt. ca. 660 m, raised bog, 2 Oct. 2004, leg. D. Dvořák (BRNU 626504).

Sweden. Uppland, "Bölinge mosse", NE part, ca. 500 m W of the road to Björling, among *Sphagnum*, *Oxycoccus palustris*, etc., at the margin of a bog, together with *Hygrophorus turundus*, 16 Sept. 1948, A. Melderig (Fungi exsiccati suecici, praesertim Upsalienses, PRM 838525).

Fig. 12. *Clavaria argillacea* var. *sphagnicola* (BRNM 747282): **a** – spores, **b** – basidia, **c** – caulocystidia. Bar = 10 µm. Del. M. Vašutová.

Distribution in the Czech Republic. One unpublished record – Českomoravská vrchovina Mts. (see above).

Distribution in Europe. Sweden (PRM 838525, Knudsen 1997), Norway (Knudsen et al. 2012), Denmark (Knudsen 1997), Belgium (Anonymus 2007), Germany (Einhellinger 1977, 1982), Switzerland (Favre 1939, 1960; Kraft 1978), Poland (see collections studied; the species was not published from Poland before), Lithuania (Shiryaev & Iršėnaitė 2009), Estonia (Shiryaev 2009), Austria (Hausknecht & Klofac 2008).

Selected descriptions. Favre (1939: 215, as *Clavaria sphagnicola*).

Selected illustrations. Deneyer (in Anonymus 2007: 170)

Notes. *Clavaria argillacea* Pers. represents a polymorphic species with several varieties described, differing in habitat, spore size and fruitbody shape and colour (e.g. Corner 1950). After some hesitation, we assume that our collections represent *C. argillacea* var. *sphagnicola* (sometimes treated as a species of its own, *C. sphagnicola* Boud.), which is typical by growth on living *Sphagnum* in bogs. The concept of this taxon in the literature is somewhat inconsistent, and also our collections differ in some respects from published descriptions.

In terms of colour, according to Boudier (1917) and Favre (1939) fruitbodies of *C. argillacea* var. *sphagnicola* are more vividly coloured than in var. *argillacea*; on the contrary, Corner (1950) describes it as paler. Our experience supports the latter opinion.

We agree with Favre (1939) that fruitbodies of var. *sphagnicola* are larger, more slender and with a more acute top. They are often compressed and have a furrow, hence resembling species of the genus *Geoglossum* in shape. On the contrary, var. *argillacea* has fruitbodies which are smaller and obtusely clavate, similar in form to e.g. *Macrotyphula fistulosa*.

Spores of var. *argillacea* are more or less cylindrical (with Q = 2 or even more) and their width usually does not exceed 5 µm (Favre 1939, Knudsen et al. 2012), which is in good accordance with selected collections studied by us (PRM 704263, PRM 168386, PRM 167660, PRM 668194, PRM 860755, PRM 516338, PRM 516409, PRM 516286, PRM 617237, PRM 777664, PRM 838534). In var. *sphagnicola*, Favre (1939), Corner (1950) and Knudsen et al. (2012) describe the spores as broadly ellipsoid (Q < 2), measuring 9–11.5 × (5)6–7 µm. Spores of our material (apart from our collections also in PRM 838525) agree in shape (being ellipsoid to ovoid, Fig. 12), but they are smaller and their size agrees well with the original description of *Clavaria sphagnicola* (Boudier 1917). The discrepancy between Boudier's spore sizes and the values presented by Favre (1939) and later authors is even wider, when the inaccuracy of Boudier's measurements is taken into consideration (they are ca. 10 % too high; van Brummelen 1969).

Clavaria argillacea var. *obtusata* Boud., described as having a spore size of 9–10 × 5–6 µm (Boudier 1917) or 8–10.5 × 5–6.5 µm (Favre 1939), differs in pale greyish to ochraceous fruitbodies with an obtuse tip and occurrence on bare peaty soil (Boudier 1917, Favre 1939).

A taxonomic solution of this group of taxa is impossible without studying the original material and is far beyond the scope of this paper. Moreover, the delimitation of *C. sphagnicola* and *C. argillacea* is the subject of a molecular study (Kautmanová, pers. comm. 2013) at present.

Ramariopsis subarctica Pilát Figs. 5, 6, 13

≡ *Clavulinopsis subarctica* (Pilát) Jülich

Description. Fruitbodies repeatedly branched, 30–60 mm high and 20–40 mm wide, shortly pubescent-hirsute and brownish yellowish at base, branches smooth or slightly rugose, dark waxy yellow to ochre yellow, tips obtuse. Context concolorous, smell and taste indistinct. Spores 5–6.5 × 5–6.5 µm, Q = 1.0–1.2, globose to subglobose, minutely spiny, spines to 0.5 µm high. Basidia 36–45 × 7–8.5 µm, mostly 4-spored, rarely 2-spored. Clamps present.

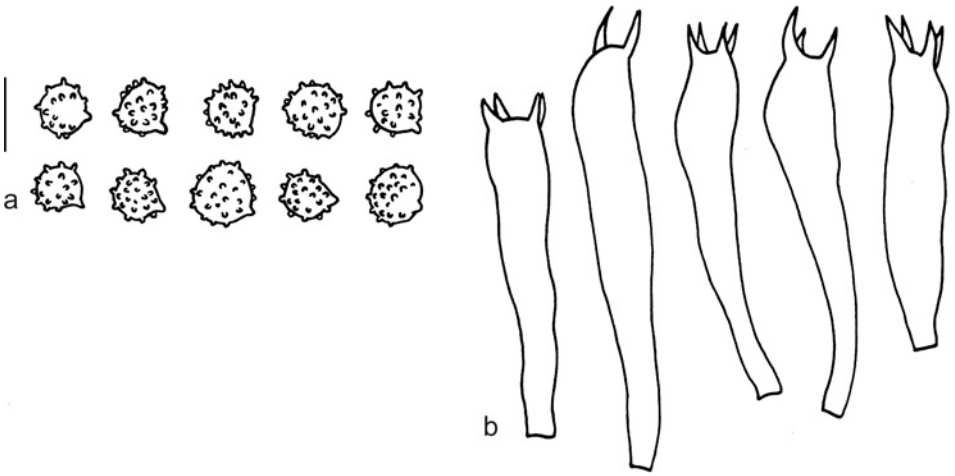


Fig. 13. *Ramariopsis subarctica* (BRNM 747285): **a** – spores, **b** – basidia. Bar = 10 µm. Del. M. Vašutová.

Collections studied

Czech Republic. Hrubý Jeseník Mts., site Vozka, *Andromedo polifoliae-Sphagnetum magellanici*, among *Sphagnum* sp., *Plagiothecium curvifolium*, litter of *Vaccinum myrtillus* and *Picea abies*, 12 Sept. 2011, leg. D. Dvořák (BRNU 626506); ibid., 29 Sept. 2011, leg. M. Vašutová (BRNM 747285); ibid., among *Sphagnum russowii* and other mosses under *Vaccinium myrtillus*, 3 Oct. 2012, leg. D. Dvořák (BRNU 626511). – Krkonoše Mts., on bank of a pool SE of Labská bouda, alt. ca. 1370 m; among *Sphagnum* sp., 24 Sept. 1955, leg. K. Komárek (PRM 704245).

Norway. Finnmark, Varangerbotn, on peat among *Dicranum elongatum*, 8 Sept. 1970, leg. A. Pilát (PRM 642715, holotypus).

Distribution in the Czech Republic. Until recently *R. subarctica* was known only from two localities in the subalpine belt of the Krkonoše Mts. (Prameny Labe, Prameny Úpy – Pilát 1972, 1974; Fellner 1996).

Distribution in Europe. *Ramariopsis subarctica* is known almost exclusively from northern Europe – Norway (Pilát 1971, Knudsen & Shiryaev 2012) and Sweden (Daun & Nitare 1987). Besides the Czech collections, there is only one locality in central Europe known to us: Slovakia, High Tatra Mts., Trojrohé pleso, open raised bog, in *Sphagnum*, 31 Aug. 1998, leg. et det. V. Antonín (BRNM 642719) – interestingly, also *Ascocoryne turficola* was found at the same locality in the past (Svrček 1957). *Ramariopsis subarctica* has not been published from Slovakia so far.

Selected descriptions. Antonín & Bieberová (1995: 23), Daun & Nitare (1987: 90–93).

Selected illustrations. Pilát (1971: plate I), Anonymus (2003: p. 78), Daun & Nitare (1987: fig. 1–3).

Notes. Records from the Hrubý Jeseník Mts. and High Tatra Mts. originate from sites near the upper timberline, which supports Pilát's idea about *R. subarctica* as a glacial relict in central Europe (Pilát 1974). On the other hand, we can neither exclude the possibility of rather recent (i.e. Holocene) long-distance transport of *Ramariopsis subarctica* from areas in northern Europe, although this seems much less probable. A final resolution is hardly possible without studying the genetic structure of central European populations in detail.

In the Krkonoše Mts., the species was found in an open bog in *Sphagnum* on the bank of a pool (Prameny Labe; Pilát 1974) and among *Rubus chamaemorus* under *Pinus mugo* shrubs (Prameny Úpy; Fellner 1996). In the Hrubý Jeseník Mts. it grew under scattered spruce trees at a peat bog margin, either on almost bare soil or among *Sphagnum* and *Plagiothecium curvifolium*. In northern Europe, *Ramariopsis subarctica* occurs among *Sphagnum* or on bare peat, often near living mosses (e.g. *Dicranum*), *R. chamaemorus*, *Betula nana* and ericaceous plants (Pilát 1971, Knudsen & Shiryaev 2012), Daun & Nitare (1987) indicate subalpine mires and intermediate fens, but also snowbed vegetation as a habitat. Thus, the species is not strictly bound to mire habitats nor to the presence of mosses.

Macroscopically, our collections fit well with published descriptions, especially with Daun & Nitare (1987), but the spores of our specimens are smaller than mentioned by Pilát (1971, 1974; 6–8 × 5–6 µm). However, spore sizes measured on the type material from Norway (PRM 642715) and on the collection from the Krkonoše Mts. (PRM 704245) correspond well with the collections from the Hrubý Jeseník Mts. We have no clear explanation for the discrepancies between our and Pilát's spore dimensions measured on the same material. Since other pale *Ramariopsis* species (e.g. *R. kunzei*) have spores not exceeding 5 µm in length and occur in different habitats, we are convinced of the identity of our collection.

Ascocoryne turficola (Boud.) Korf Figs. 7, 14

≡ *Sarcoleotia turficola* (Boud.) Dennis, ≡ *Ombrophila turficola* (Boud.) Svrček

Description. Fruitbodies solitary or in tufts. Apothecia in young stage turbinate to disc-shaped, flat to somewhat concave at the top, soon enlarged to a fertile „cap" above and tapering to a „stipe" below, finally up to 25 mm wide and 40 mm high. Thecium disc-shaped to pulvinate, sometimes slightly cyathiform, with wavy, slightly involute, sharp margin and smooth or scrobiculate surface, distinctly olive coloured, later thinning and more irregularly undulate to wavy, with distinctly involute margin, discolouring to fleshy colours with olive tinge. Tapering sterile part at first almost whitish with pink tinge, later flesh-coloured, sometimes with violet tinge. Context gelatinous, elastic; in mature fruitbodies the lower part of the stem is watery-gelatinous, very soft and difficult to extract from the

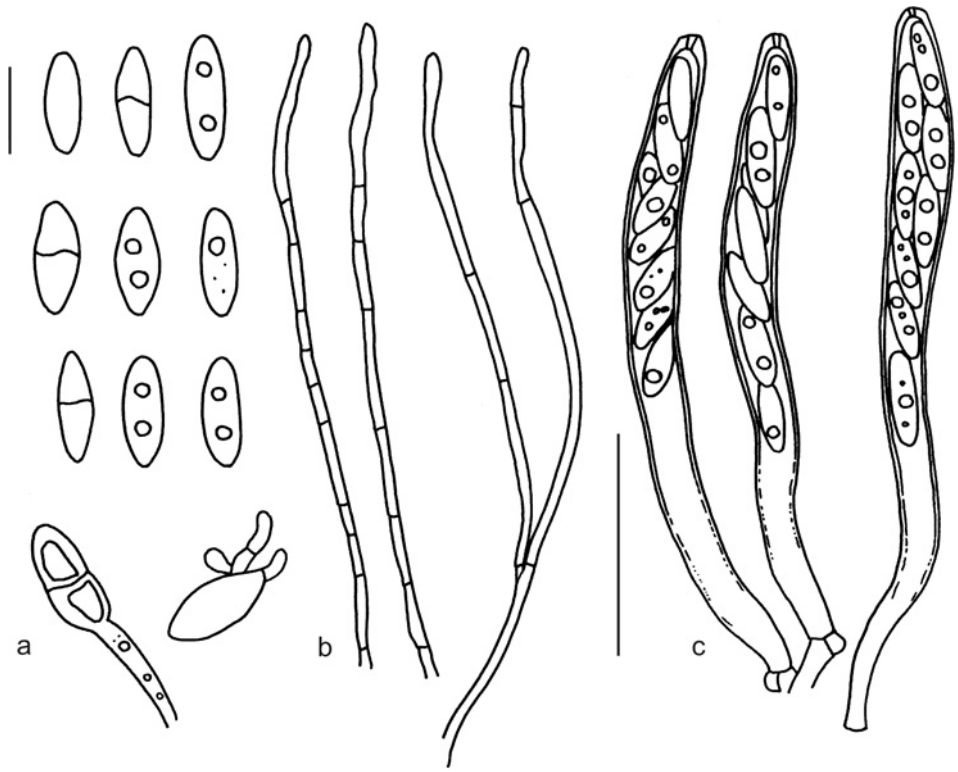


Fig. 14. *Ascocoryne turficola* (BRNM 747286): **a** – spores, **b** – paraphyses, **c** – asci. Bar = 10 µm for spores, 50 µm for other structures. Del. M. Vašutová.

substratum without damage. Asci arising from croziers, cylindrical, 107–130 × 8–10 µm, 8-spored, uniseriate to biseriate, apical apparatus strongly amyloid. Spores fusoid, 13–15.5(16) × (4)4.5–5(5.5) µm, unicelullar, later with one septum, mostly with 2 drops, smooth, hyaline. Paraphyses filiform, sometimes branched, septate, smooth, upper part 2–3 µm wide.

Collections studied

Czech Republic. Hrubý Jeseník Mts., site Barborka, *Drepanoclado fluitantis-Caricetum limosae*, among *Sphagnum* submersed in water, 24 Aug. 2011, leg. H. Deckerová; ibid., 12 Sept. 2011, not. H. Deckerová; ibid., among *Warnstorfia fluitans*, 29 Sept. 2011, leg. M. Vašutová (BRNM 747288). – Site Trojmezí II, *Drepanoclado fluitantis-Caricetum limosae*, 12 Sept. 2011, not. D. Dvořák; ibid., remains of mosses and *Carex limosa*, 29 Sept. 2011, not. M. Vašutová; ibid., 6 Nov. 2011, not. D. Dvořák. – Site Trojmezí I, *Drepanoclado fluitantis-Caricetum limosae*, 15 Sept. 2008, leg. M. Beran (BRNM 747286); ibid., 31 Aug. 2009, leg. M. Beran (CB 16302); ibid., 6 Sept. 2010, leg. M. Kříž (BRNM 747287); ibid., remains of *Carex limosa* and *Warnstorfia fluitans*, 29 Sept. 2011, leg. M. Vašutová (CB17101); ibid., 6 Nov. 2011, not. D. Dvořák. – Site Vozka, *Drepanoclado fluitantis-Caricetum limosae*, among *Sphagnum*, 12 Sept. 2011, not. H. Deckerová; ibid., on *Sphagnum* remains, 29 Sept. 2011, not.

M. Vašutová. – Jizerské hory Mts., Rašeliniště Jizerky NNR, near hollow, 50°49'40.1" N, 15°19'40.9" E, 14 Sept. 2010, on *Sphagnum* remains, leg. M. Vašutová (CB 16751); ibid., 20 Sept. 2011, not. J. Běťák; ibid., 5 Oct. 2011, not. M. Vašutová. – Krušné hory Mts., Velký močál NNR, raised bog, among mosses at the bank of a pool, 13 Oct. 2011 leg. O. Knápek (BRNU 626508).

Distribution in the Czech Republic. Krušné hory Mts. –Velký močál NNR (see above), Šumava Mts. – Zadní mlynářská slať, Rokytecká slať (Holec et al. 2002), České středohoří – Březina NR, peat bog below Bukový vrch (Svrček 1957), Třeboňsko – Třeboň, bank of pond Stupský rybník (Kubička 1955), Jizerské hory Mts. – Rašeliniště Jizerky NNR (see above), Krkonoše Mts. – Labská louka, leg. O. Šída (PRM 899719), Hrubý Jeseník Mts. – Praděd NNR, Bílá Opava stream valley, leg. M. Kříž (PRM 899288).

Distribution in Europe. Norway, Sweden, Finland, Denmark, Great Britain, Ireland, the Netherlands, France, Germany, Poland, Slovakia, Switzerland, Italy (Svrček 1957, Stasińska & Sotek 2004, Karasch & Hahn 2009, Stasińska 2011, van Vooren 2012).

Selected descriptions. Holec et al. (2002: 112), van Vooren (2012: 40), Kubička (1955: 90), Bunyard et al. (2008: 25-26).

Selected illustrations. van Vooren (2012: p. 41, 43, 44), Kubička (1955: p. 91), Holec et al. (2002: figs. 2, 3, 4), Bunyard et al. (2008: figs. 2, 6, 10, 11).

Notes. In the Czech Republic the species is currently known only from mountain bogs at altitudes above 850 m; only two old, now disturbed localities, where the species has probably vanished, lie at lower altitudes (ca. 570 m a.s.l. – Březina, ca. 420 m a.s.l. – Stupský rybník). According to our observations from the Hrubý Jeseník Mts., Jizerské hory Mts. and Krušné hory Mts., *Ascocoryne turficola* grows in places near the water level, primarily on banks of bog pools either on bare peat or in carpets of *Sphagnum* spp. or *Warnstorfia fluitans*, sometimes among remains of *Carex* spp. The collection by Kříž (PRM 899288) originates from a wet depression with *Sphagnum* in montane old-growth spruce forest with an open canopy. Our experience is in accordance with Stasińska (2011), who emphasises the high water level requirements of *A. turficola* in north-west Poland. We did not find a specific linkage to any *Sphagnum*, other moss or plant species. While *Sphagnum* is mostly being noticed as an associated organism, Stasińska & Sotek (2004) observed association with *Carex rostrata*, and Dissing (2000) mentions growth on cyperaceous stems in *Sphagnum*. Bunyard et al. (2008) even discuss the possibility that it grows on wood remnants sunk in the moss or peat layer. This seems unlikely to us, since most of our collections originate from places without trees or shrubs in vicinity. The real trophic status and substrate preferences of *A. turficola* remains unclear, but the species is most likely a saprophyte growing on dead tissue of hygrophilous mosses and probably also some vascular plants. Van Vooren (2012) reported several records in spring.

Although our localities were monitored throughout the whole season, *A. turficola* only fructified from late August till early November.

The size of the spores, especially their length, as well as the presence of a septum seems to be rather variable character. For details and further discussion, see Nuss & Oertel (1973) and Bunyard et al. (2009).

ACKNOWLEDGEMENTS

The research was funded by the Czech Science Foundation, project no. GA 206/08/0389. We thank Helena Deckerová, Martin Kříž, Martin Jiroušek and Martin Kočí for their invaluable help in the field survey. Martin Kříž kindly provided his photographs, Martin Jiroušek and Markéta Táborská identified *Sphagnum* and other moss species. We are indebted to Neria Roemer for providing information on the Swiss collection of *Omphaliaster borealis* and to Ivona Kautmanová for discussing the taxonomy of *Clavaria argillacea* var. *sphagnicola*. We are also grateful to Lenka Edrová for loaning collections from PRM, to Petr Hesoun for providing his *Clavaria* collection for study, and to Vladimír Antonín for loaning collections from BRNM herbarium. Finally we would like to thank Jan Holec and two anonymous reviewers for invaluable comments and improvements.

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