

into one of the two major *Cora* clades (Lücking et al. 2014). A closer relative of *C. barbulata* is the terrestrial *C. arachnoidea* J. E. Hern. & Lücking (Fig. 128a–c), which is grey-brown when fresh and uniformly thinly tomentose on the upper surface (Lücking et al. 2013). *Cora barbulata* can be distinguished from *C. aspera* mainly by the coarsely crenulate, undulate lobe margins and the different hymenophore, forming large, irregularly dispersed patches on the underside.

217. *Dictyonema gomezianum* Lücking, Dal-Forno & Lawrey, *sp. nov.*

Index Fungorum number: IF551502; *Facesoffungi number*: FoF01050; Fig. 131d–f

Etymology: Dedicated to the late Dr. Luis Diego Gómez, prominent Costa Rican botanist, naturalist, and conservationist and long-time director of Las Cruces Biological Station.

Holotype: R. Lücking 18053 (CR).

Diagnosis: Differing from the morphologically similar and related *Dictyonema metallicum* in the narrower cyanobacterial filaments with more or less paraplectenchymatous hyphal sheath and the very narrow associated hyphae.

Thallus epiphytic on tree trunks and overgrowing nearby bryophytes, appressed filamentous, continuous, up to 5 cm across, forming a strongly compressed mat of horizontal, densely interwoven, dark aeruginous fibrils almost completely embedded in a gelatinous matrix with metallic shimmer, except for a broad, white, opaque, byssoid prothallus; thallus in section 50–100 µm thick, composed of an irregular photobiont layer and an irregular medulla or hypothallus. Photobiont *Rhizonema*, in a layer composed of numerous cyanobacterial filaments wrapped in a closed hyphal sheath formed by small, paraplectenchymatous or indistinctly jigsaw puzzle-shaped cells; cyanobacterial filaments composed of 7–9 µm wide and 3–5 µm high, dark aeruginous cells penetrated by tubular fungal hyphae; heterocytes sparse, yellowish, 6–10 µm wide and 2–4 µm high; cells of hyphal sheath angular to slightly wavy in lateral outline, 1.5–2 µm thick; hyphae associated with hyphal sheath straight, 2–3 µm thick, lacking clamp connections; compacted prothallus mostly formed by densely arranged empty hyphal sheaths admixed with straight hyphae. *Hymenophore* not observed. *Secondary chemistry*: no substances detected by TLC.

Material examined: COSTA RICA, Puntarenas, Las Cruces Biological Station near San Vito de Coto Brus; 82° 58' W, 08° 47' N, 1200 m; lower montane rain forest zone, on ridge beyond Río Java, on trunk of tree in disturbed primary forest; October 2004, R. Lücking 18053 (CR **holotype**; F **isotype**).

Distribution and ecology: Known from lower montane rain forest in southern Costa Rica in the broader southern Central American Choco region.

Notes: *Dictyonema gomezianum* is similar and closely related to the recently described *D. metallicum* Lücking et al.

(2013). Both share the strongly appressed, filamentous thallus in which the horizontally oriented fibrils are embedded in a gelatinous matrix that gives the thallus a strong metallic shimmer. While the phylogenetic distance between *D. metallicum* and its sister species, *D. gomezianum*, is considerable (Dal-Forno et al., in prep.), the morphological differences are minor: *D. metallicum* has a thinner thallus with indistinct medulla, the cyanobacterial filaments are broader (likely influenced by the fungus which produces a sheath with more distinctly puzzle-shaped cells), and particularly the associated fungal hyphae are thicker (4–6 µm).

Inocybaceae Jülich

The family *Inocybaceae* is a monophyletic lineage within *Agaricales*. It is species rich and has a worldwide distribution. The species are small to medium sized with a brown spore deposit, and most species form ectomycorrhiza with a broad range of host trees and shrubs. Besides *Inocybe* the family today include *Tubariomyces* (Alvarado et al. 2010) and *Auritella* (Matheny and Bougher 2006).

Inocybe (Fr.) Fr. Monogr. Hymenomyc. Suec. (Upsaliae) 2(2): 346 (1863)

As currently circumscribed, *Inocybe* is a morphologically and genetically diverse genus. Molecular phylogenetic analyses suggest the genus can be divided in the four major lineages, *Inocybe* s.s., *Pseudosperma*, *Inosperma* and *Mallocybe* (Larsson et al. 2009; Ryberg et al. 2010), and the family *Inocybaceae* to be composed of at least seven evolutionary lineages (Matheny 2009; Matheny et al. 2009). However, the proposed taxonomical rearrangements have not yet been fully implemented.

The species in subgenus *Mallocybe* are frequently encountered in arctic/alpine, subalpine and boreal habitats (Cripps et al. 2010; Jacobsson and Larsson 2012). Many of the species are associated and forming ectomycorrhiza with dwarf and shrub *Salix* species. Morphology, ecology and comparison of sequence data, including ITS sequences of type specimens, support the recognition of a new species in subgenus *Mallocybe* from the northern boreal and subalpine regions of Scandinavia, associated with *Salix phyllifolia* on more calcareous ground (Fig. 129).

218. *Inocybe granulosa* Jacobsson & E. Larss., *sp. nov.*

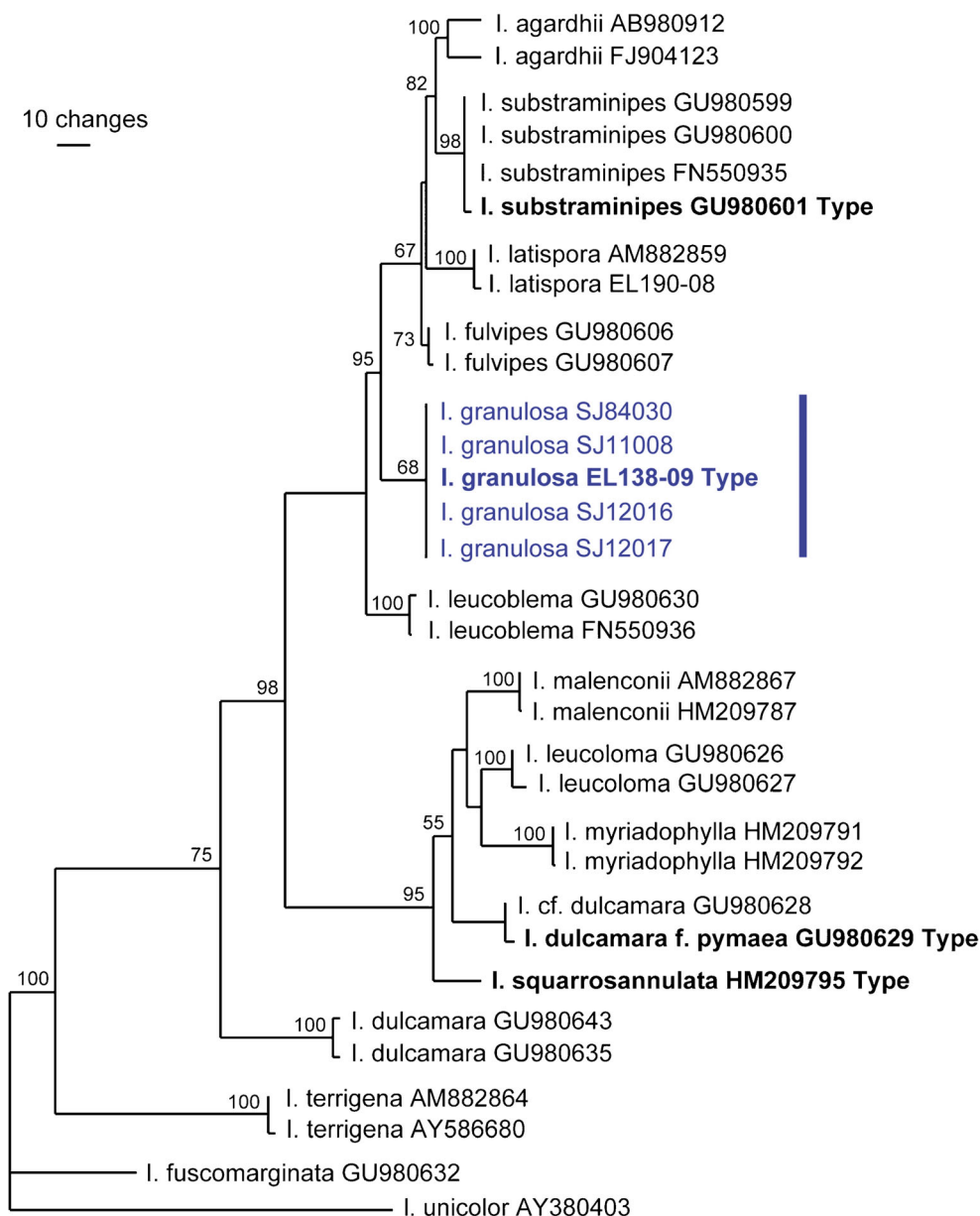
Mycobank number: MB 812048; *Facesoffungi number*: FoF00989; Figs. 130 and 131.

Etymology: Refers to the granular small scaly appearance of the stipe and pileus.

Holotype: SWEDEN, Jämtland, Berg, close to Lake Storsjön, 4 km N Svenstavik, 1 September 2009, E. Larsson 138-09 (Herbarium GB).

Pileus 10–32 mm diam., at first convex with an incurved margin, then expanded, when mature flat or frequently with

Fig. 129 Phylogram from the analysis of ITS and LSU rDNA sequence data (PAUP*, Version 4) showing the position of *Inocybe granulosa* in relation to closely related species in the subgenus *Mallocybe*. Bootstrap values are indicated on branches. Sequences of type specimens are in *bold*



somewhat depressed centre, not umbonate, at first pale yellowish, later becoming yellowish brown at least in the centre, covered by numerous small, floccose scales. The scales are often pointed and upraised at least in the centre, at first yellowish brown, sometimes but not always becoming dark brown with age. The scales often loosen and disappear at least partly in mature basidiomata. *Lamellae* normally distant, at first pale beige to yellowish, gradually rather dark greyish brown with a paler edge. *Stipe* 15–35 mm long, 2–4 (5) mm wide, equal or somewhat thicker towards the base, pale yellowish brown with a white base, with granular to floccose brownish scales similar to those on the cap. *Veil* beige sometimes forming a thin and evanescent annulus. *Flesh* pale, whitish without distinct smell, taste mild. *Basidia* clavate, 35–45 ×

8–11 μm, 4-spored, sometimes with brownish necropigments. *Spores* (8–)9–12 × 5–7(–7.5) μm, $Q=1.4$ –1.8, mostly ellipsoid and slightly phaseoliform in profile. *Cheilocystidia* numerous, more or less septate with a broadly clavate to almost globose end cells, 12–24 μm broad, thin walled, some with brownish necropigments, Fig. 3. *Pleurocystidia* absent. *Clamp-connections* present.

Habitat: On sandy roadsides or gravelly ground, often near mines or industrial sites, likely associated with *Salix phyllicifolia* but probably also with other *Salix* species. Likely favoured by calcareous ground.

Distribution: Found in upper boreal and subalpine zones in the western part of the provinces of Jämtland and Härjedalen, central Sweden and in adjacent parts of central Norway.



Fig. 130 Basidiomata of *Inocybe granulosa* (holotype)

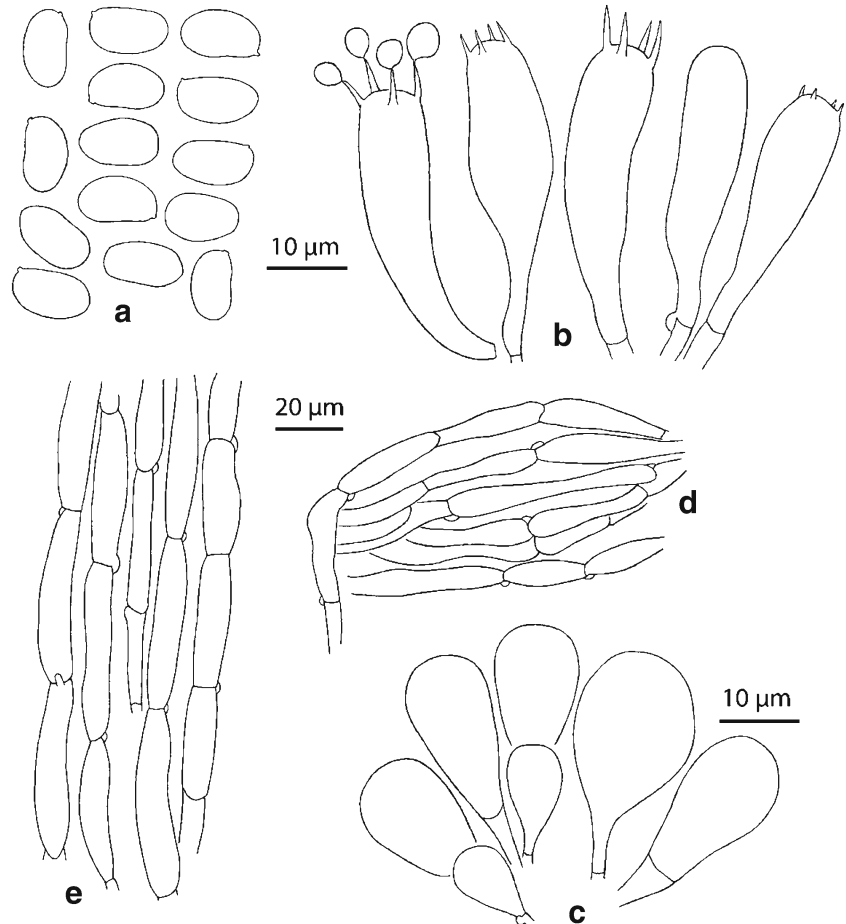
Rather common and often abundant in its special habitat in central Scandinavia but so far not known outside this area.

Material examined: SWEDEN, Jämtland, Åre, Handöl, sandy road-side with *Salix*, 10 August 1984, S. Jacobsson 84030 (GB); Jämtland, Berg, N Svenstavik, resting-place, among *Salix phyllicifolia*, 1 September 2009, E. Larsson

138-09 (GB, **holotype**) (**Isotypus** TUR-A); the same locality 26 August 2011, S. Jacobsson 11007 (GB); Jämtland, Åre, Undersåker, Nulltjärnsgården, road-side with *Salix*, 27 August 2011, S. Jacobsson 11008 (GB); Härjedalen, Tännäs, Bruksvallarna, roadside with *Salix phyllicifolia* 2 July 2012, S. Jacobsson 12002 (GB). NORWAY, Hedmark, Folldal, on clinkers close to the mine, 23 August 2012, S. Jacobsson 12016 (GB); Oppdal, Dovre, Hjerkin, roadside with *Salix phyllicifolia*, 20 August 2012, S. Jacobsson 12017 (GB).

Notes: Members of subgenus *Mallocybe* frequently occur in boreal, subalpine and arctic/alpine regions (Kühner 1988; Cripps et al. 2010). Several of these species may have more or less distinct scales on the pileus surface and some of them may possibly be mistaken for *Inocybe granulosa*. The most similar species in the literature is *I. squarrosoannulata* (originally described as *I. dulcamara* f. *squamosoannulata* by Favre 1955) encountered in alpine environments growing with dwarf *Salix*. It is depicted with distinct scales both on the pileus surface and the stipe (Bon 1997; Ferrari 2006), but the scales are coarser than in *I. granulosa* and arranged in garlands, somewhat similar to *I. terrigena* (Fr.) Kuyper. Comparison of ITS sequence data of the holotype (Fig. 1)

Fig. 131 Micro-morphological characters of *Inocybe granulosa* (holotype) **a** spores **b** basidia **c** cheilocystidia **d** hyphae of pileipellis **e** stipe surface hyphae



show that *I. squarrosoannulata* and *I. granulosa* are distinct species.

Another species about the same size and colour as *I. granulosa* and with similar habitats and ecology is *I. malenconii* Heim. However, the pileus is more finely scaly and the scales are absent or rare on the stipe. In micromorphology *I. malenconii* is easily separated from *I. granulosa* by having a narrowly cylindrical spore shape, more reminiscent of those of *I. lacera* (Fr.) P. Kumm. *Inocybe malenconii* was described from France (Heim 1931) and is widely distributed. It has been recorded several times in central Sweden and the Nordic countries, often found along roadsides (Jacobsson and Larsson 2012).

Inocybe granulosa is readily identified in the field and commonly encountered in a restricted part of central Scandinavia, but so far not known outside this region. Despite similarity in macro-morphology with *I. malenconii* and *I. squarrosoannulata* the phylogenetic analysis (Fig. 1) indicate *I. granulosa* to be more closely related to *I. agardhii* (Lund) P.D. Orton, *I. substraminipes* Kühn. and *I. fulvipes* Kühn., all growing associated with *Salix*.

Boletales

Boletaceae Chevall.

The family *Boletaceae* is characterized by species developing their spores in a tubular hymenophore on the underside of the pileus, although some species (e.g., those in the genus *Phylloporus* Quél.) show highly anastomosed lamellae and others exhibit a hypogeous behavior. *Boletaceae* species produce fleshy basidiomes, sometimes quite large, with a central stipe. The spore print colours vary from olivaceous-tobacco-brown to yellow, yellowish or vinaceous. In many species, flesh after wound or cut turns blue, as a result of the oxidation of pulvinic acid derivatives.

Singer (1986) included 26 genera in this family. Molecular phylogenetic studies of the 2000s have revised the concept of the family: Binder and Hibbett (2006) recognized 38 genera. Some changes in classification have moved some genera out of the *Boletaceae*; nevertheless, it remains a large family with many genera. According to the Kirk et al. 2008a, b, 35 genera are recognized; in the overall work of Wu et al. (2014), seven major clades at subfamily level and 59 generic lineages were uncovered, including 4 new subfamilies and 22 new potential generic clades (Fig. 132).

Xerocomellus Šutara, Czech Mycol. 60(1): 44 (2008)

The genus *Xerocomellus* was described by J. Šutara (2008) with *X. chrysenteron* (Bull.) Šutara as the type species. This genus, segregated from *Xerocomus*, included species characterized by a pileipellis arranged from the early stage in a characteristic palisadoderm of incrustated hyphae, and a spore surface which is never bacillate, but smooth or with specialized apex (“truncature”) and/or longitudinally striate. As originally circumscribed, the genus included *X. armeniacus* (Quél.)

Šutara, *X. engelii* (Hlavaček) Šutara (= *Xerocomus communis* (Bull.) Bon s. auct), *X. fennicus* (Harmaja) Šutara, *X. marekii* (Šutara & Skala) Šutara, *X. porosporus* (Imler ex Moreno & Bon) Šutara, *X. pruinatus* (Fr.) Šutara, *X. ripariellus* (Redeuilh) Šutara and *X. rubellus* (Krombh.) Šutara. *Xerocomus cisalpinus* (Simonini et al.) Klofac was included in the genus by Klofac (2011). In 2014, *Xerocomus dryophilus* was also included in this genus as *X. dryophilus* (Thiers) N. Siegel et al. (Frank 2014). Vizzini (2015) established for *Boletus rubellus* Krombh. (= *X. rubellus* (Krombh.) Šutara) the new genus *Hortiboletus* Simonini et al. and for *Xerocomus armeniacus*, as well as for the close *Xerocomus persicolor* H. Engel et al., the new genus *Rheubarbariboletus* Vizzini et al.

219. ***Xerocomellus sarnarii*** Simonini, Vizzini & Eberhardt, *sp. nov.*

Index Fungorum number: IF551434; *Facesoffungi* number: FoF01047; Figs. 133 and 134

Etymology: dedicated to our friend Mauro Sarnari, who found this bolete at Monte Argentario.

Holotype: MCVE 28577

Colour terminology and alphanumeric codes are those of Kornerup and Wanscher (1978) and Seguy (1936).

Pileus 35–90 mm broad, fleshy, convex to pulvinate, rarely almost plane, also slightly depressed at the centre but conserving pulvinate shape; surface dry, tomentose-velutinous, soon cracking into scabs independently on weather conditions, with a subpellis very weakly and not always pink-reddish coloured, being this colour rarely visible in the fissures, sometimes only in the bites of the snails; surface variable in colour: in very young basidiomes with uncracked pileus dark brown with olive shade (6–7/F6–F4, 6/F8–F7), with fading patches (5/D5–D3), cracking into scabs and discolouring to ochre-beige with olive shade (4–5/D6–D3), passing through transition colours (5–6/D7–F4). Dull cream-whitish (3/4A2) cracks appear beneath the pileipellis layer in dry weather.

Tubes up to 5–10 mm long, separable, depressed to sinuate around the stipe, sometimes slightly decurrent, as high as the context of the pileus or even more; initially bright yellow with olive shades (1/2A7/8, 3A/B7/8), later dull greenish yellow (2C/D7/8, 3/4C/D6), bluing then darkening to blackish when bruised. *Pores* angular, uneven, in mature basidiomes 0.7–2 mm diam., concolourous to the tubes, slowly bluing (S351, 352, 366, 367) then darkening to blackish when bruised. *Stipe* 30–90 × 5–25 mm, cylindrical, slender, curved, somewhat tapering towards the base or also slightly widened. Surface dry, smooth to ingrown fibrillose, chrome yellow in the upper part, in the lower part and towards the base or partially or completely, sometimes abruptly, red, dark purple red or even blackish-red coloured (11–12/D8–F4). *Context* soft in