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Cortinarius subgenus *Phlegmacium* section *Aureocistophili* in Europe

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Abstract

The taxonomy and phylogeny of sect. *Aureocistophili* (*Cortinarius*, subgen. *Phlegmacium*) are presented. The section is well circumscribed by molecular data and morphological features. We identify nine species in the section, two of which are undescribed. The study is based largely on data from our own collections; however, in three cases (*C. aureocistophilus*, *C. kytoevuorii*, and *C. inusitatus*) descriptions follow the protologues. In the study we generated nineteen new sequences, which serve as the base for a phylogram covering the section and other relevant portions of the subgenus. Species of section *Aureocistophili* are widespread all over Europe, from Fennoscandia to the Mediterranean. They grow on soils of varied acidity and with various coniferous and deciduous trees. Although more material is needed for some species, we publish here a provisional key of the section.

Résumé

Cet article traite de la taxinomie et de la phylogénie de la section *Aureocistophili* (*Cortinarius*, sous-genre *Phlegmacium*). Celle section est bien délimitée, à la fois par des données moléculaires et par des caractères morphologiques. Dans la section *Aureocistophili,* on a jusqu'à maintenant identifié neuf taxons, dont deux qui ne sont pas encore décrits. La présente étude se base largement sur des données qui proviennent de nos propres récoltes, mais toutefois nous suivons les descriptions originales pour trois espèces (*C. aureocistophilus*, *C. kytoevuorii* et *C. inusitatus*). Pour cette étude, on a établi en tout dix-neuf séquences nouvelles, qui ont servi de base à un phylogramme de la section. Les espèces de la section *Aureocistophili* sont répandues dans toute l'Europe, de la Fennoscandie aux régions méditerranéennes. Elles poussent sur des sols d'acidité diverse et sont associées à différents conifères et feuillus. Nous présentons ici une clé provisoire de la section, bien que pour quelques espèces d'autres récoltes eussent été nécessaires.

Zusammenfassung

Es werden die Taxonomie und die Phylogenie der Sekt. *Aureocistophili* (*Cortinarius*, Untergattung *Phlegmacium*) dargestellt. Die Sektion ist sowohl durch molekulare Daten als auch morphologische Merkmale gut abgegrenzt. In der Sektion *Aureocistophili* wurden bis jetzt neun Taxa identifiziert, davon zwei noch nicht beschriebene. Die vorliegende Arbeit fußt weitgehend

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auf Daten, die von unseren eigenen Kollektionen stammen, bei dreien jedoch folgen wir den Originalbeschreibungen (*C. aureocistophilus*, *C. kytoevuorii* und *C. inusitatus*). Insgesamt wurden für diese Studie neunzehn neue Sequenzen erstellt, die als Grundlage für ein Phylogramm der Sektion dienten. Die Arten der Sekt. *Aureocistophili* sind in ganz Europa von Fennoskandien bis in mediterrane Gebiete verbreitet. Sie wachsen auf Böden unterschiedlichen Säuregrades und sind mit verschiedenen Nadel- und Laubbäumen vergesellschaftet. Wir präsentieren hier einen vorläufigen Schlüssel der Sektion, obwohl von einigen Arten weitere Funde benötigt würden.

Riassunto

Viene presentata la tassonomia e la filogenia della Sez. *Aureocistophili* (*Cortinarius*, sottogenere *Phlegmacium*). La Sezione è ben delimitata sia dai dati molecolari così come dalla caratteristiche morfologiche. Nella Sezione *Aureocistophili* erano finora identificati nove taxa, di cui due non ancora descritti. Il presente lavoro è basato sui dati provenienti dalle nostre raccolte personali, ma in tre casi le descrizioni sono basate sui protologhi originali (*C. aureocistophilus, C. kytoevuorii* e *C. inusitatus*). Nello studio noi abbiamo generato 19 nuove sequenze, che sono servite come base per un filogramma della Sezione e di altre rilevanti parti del sottogenere. Le specie della Sezione *Aureocistophili* sono distribuite in tutta Europa dalla Fennoscandia fino ai territori mediterranei. Esse crescono su terreni di differenti gradi di acidità e sono associate a diverse conifere e latifoglie. Presentiamo qui una chiave provvisoria della Sezione, pur essendo necessari per alcune specie ulteriori ritrovamenti.

Resumen

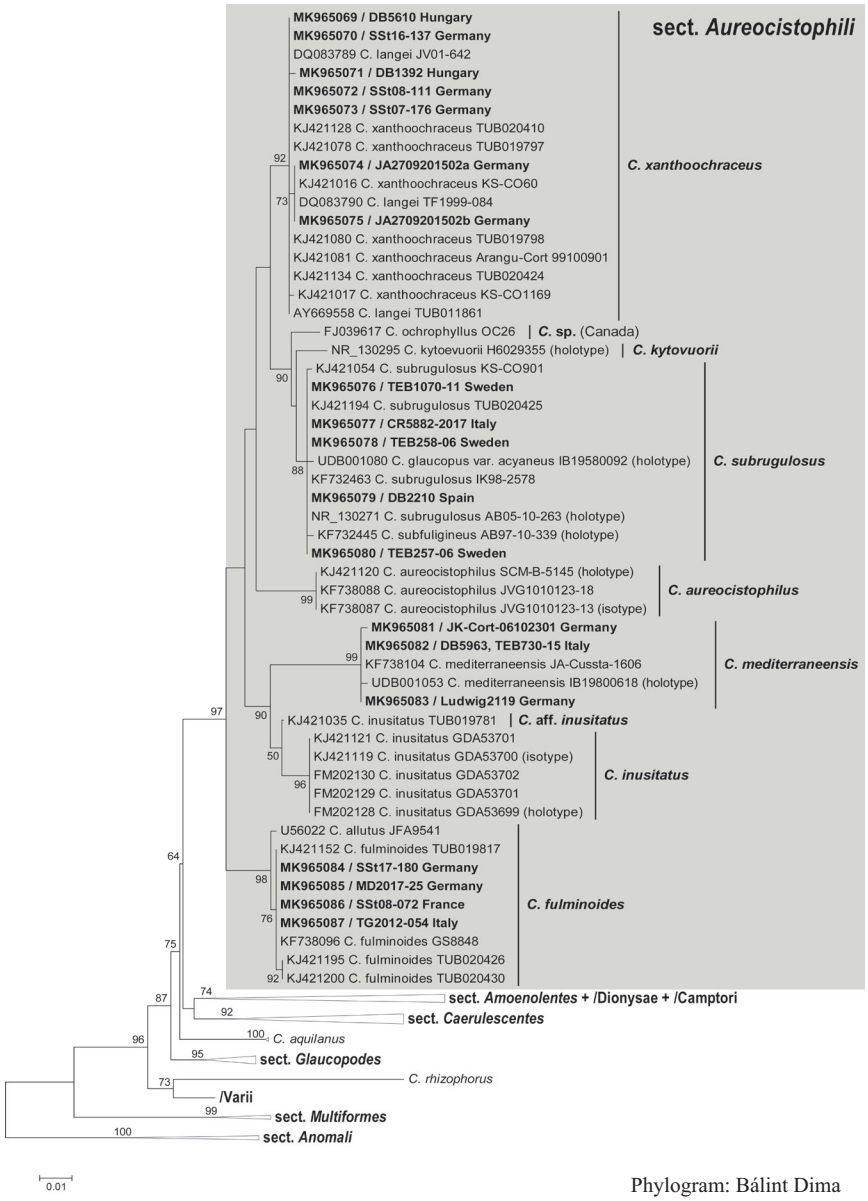
Se presenta la taxonomía y la filogenia de la secc. *Aureocistophili* (*Cortinarius*, subgén. *Phlegmacium*). La sección está bien delimitada por los datos moleculares y las características morfológicas. En la sección identificamos nueve especies, dos de las cuales no han sido descritas aún. El estudio se basa mayoritariamente en los datos de nuestras propias colecciones; sin embargo, en tres casos (*C. aureocistophilus*, *C. kytoevuorii* y *C. inusitatus*), las descripciones siguen los protólogos. En el estudio hemos generado diecinueve secuencias, que sirven de base para un filograma que abarca la sección y otras porciones del subgénero. Las especies de la secc. *Aureocistophili* están ampliamente distribuidas, desde Fenoscandia a la zona Mediterránea. Se dan sobre suelos con diferente grado de acidez y con diversos bosques de coníferas o planifolios. Aunque se necesita más material para definir algunas especies, publicamos aquí una clave provisional para la sección.

Key words • Mots clés • Schlüsselwörter • Palabras clave • Parole chiave: *Basidiomycota*, phylogeny, coniferous and deciduous forests, taxonomy.

Introduction

The *Aureocistophilus* clade in *Cortinarius* was introduced by Fernández-Brime et al. (2014). It was formed by six phlegmacioid fungi characterised by a mostly yellowish pileus and a white stipe with a more or less marginate bulb. This clade was also recovered (but without a name) by Garnica et al. (2016), where it included two more species, one of which was undescribed. The clade was recently promoted to section rank (Soop et al., 2019). *Cortinarius* sect. *Aureocistophili* is well supported by molecular markers, and shown to occur within a populous lineage of many European and North American *Phlegmacium* clades in the global phylogeny of the genus. Its nearest sisters appear to be sect. *Caerulescentes* and the *Subolivascentes* clade.

Several members of sect. *Aureocistophili* morphologically resemble those of sect. *Multiformes*, as also noted by Fernández-Brime et al. (loc. cit.). *Multiformes*, however, is positioned in a different phlegmacioid lineage that also includes clades from the Southern Hemisphere [Garnica et al., 2016, Suppl. Fig. 2; Soop et al. (loc. cit.), Fig. 1–2].



Phylogram: Bálint Dima

Fig. 1 — Maximum likelihood phylogenetic tree depicting the relationship between *Corinarus* sect. *Aureocistophili* and its nearest *Phlegmacium* sections. ML bootstrap support values are shown above 50 %.

Species in sect. *Aureocistophili* grow in a variety of habitats, from the coniferous boreal/subboreal taiga belt to the Mediterranean *Quercus* and *Cistus* communities. So far, almost all species

have been reported from Europe. The aim of this study is to review the taxonomy and phylogeny of the section in the light of recent research.

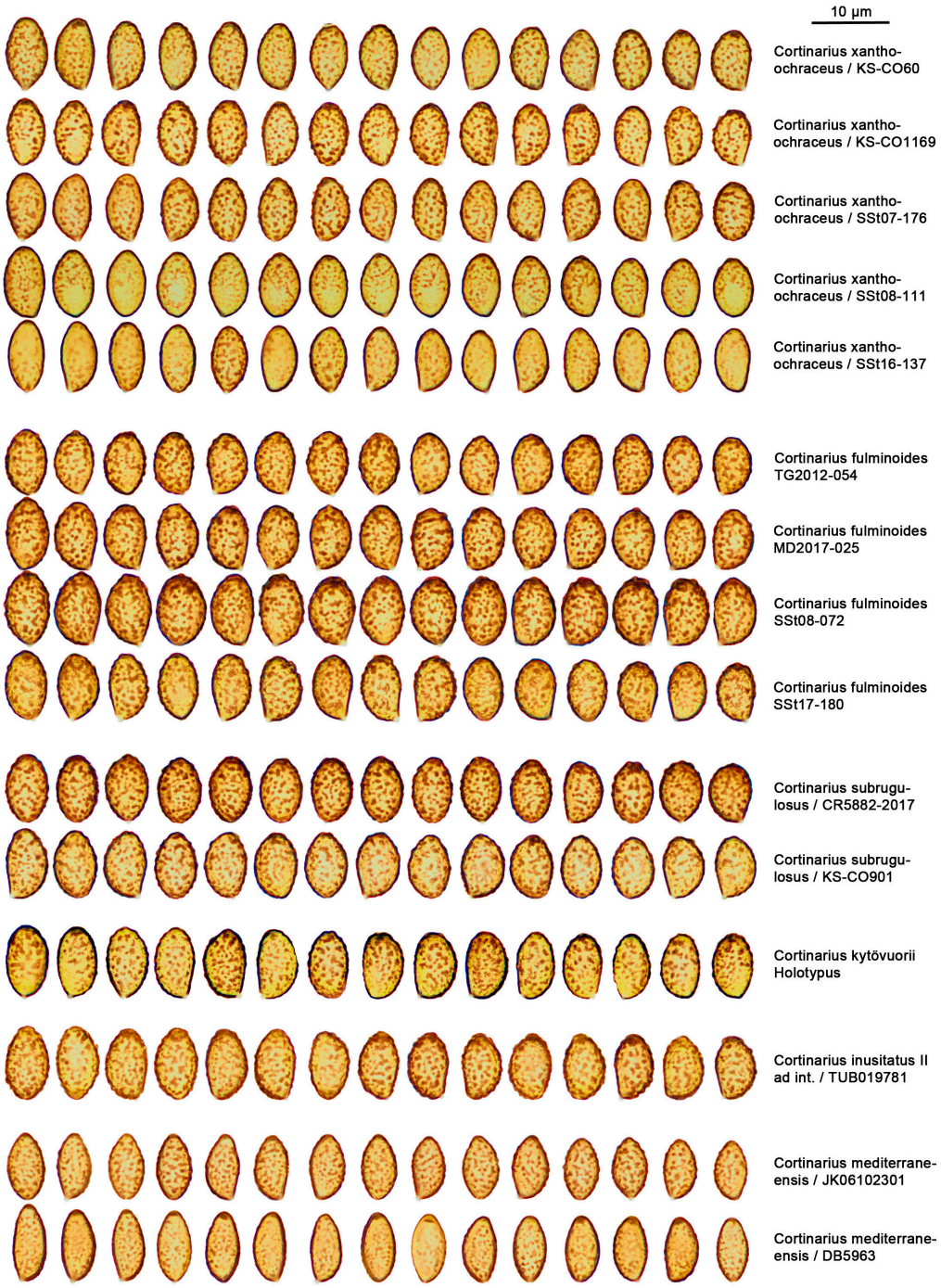


Photo: Geert Schmidt-Stohn

Fig. 2 — Spore morphology among selected samples examined in the study

Materials and Methods

Macro- and microscopic descriptions

The collections were photographed in the field or in the laboratory and detailed descriptions were made using fresh material. In most cases only dried material was available for the microscopic analysis.

Since it was not always possible to obtain a sufficient quantity of spores deposited on the stipe or cortina, a spore preparation from the gills was made for each collection. Spores from gill preparations proved on average to be 0.2 to 0.5 µm longer than deposited spores. This is due to the fact that the spores, during maturation, reduce their water content and thus shrink. Gill preparations contain a certain portion of unripe spores, which increases the average spore length. For the above reason, spore size statistics are exclusively based on measurements from gill preparations.

Measurements and photographs were made in L4 solution according to Clémençon (Clémençon, 1972, Erb et al., 1983). Spore sizes indicated in the text refer to a 95 % confidence interval in order to exclude aberrant spores. In the descriptions, the number of analysed collections, carpophores, and single spores are indicated (in this order) in square brackets. MV refers to the average value, and Q_{MV} to the average length/width quotient (Q = L/W). Focus stacking was used to produce the microphotographs (Fig. 2) by processing 20 to 30 single images at different focal distances (c. 0.2 µm per step) to obtain the final image (Schmidt-Stohn, 2011).

Molecular data

For the amplification and sequencing of the nrDNA ITS region, the 'Phire Plant Direct PCR-Kit' was used with protocols following Papp & Dima (2018). The sequencing was carried out by the LGC Genomics at Berlin. The generated sequences were edited with 'Codon Code Aligner 8.0.1'. The newly generated sequences were deposited in GenBank (Figure 1).

Phylogenetic reconstruction

Sequences were aligned with MAFFT online version 7 (Katoh & Standley, 2013) after downloading the closest BLAST hits from GenBank and UNITE. Where the D1/D2 region of nrLSU were available, we kept them in the alignment for improving our phylogeny. A number of samples from morphologically similar sections were also added to the dataset. Sect. *Anomali* was chosen as outgroup. Maximum Likelihood analysis was carried out in PhyML online version (Dereeper et al., 2008). For testing branch support the Approximate Likelihood-Ratio Test (aLRT) and the GTR+I+G substitution model were applied. The number of substitution rate categories was set to 12.

Results and Discussion

The alignment process resulted in a dataset of 74 sequences and 1358 sites. A phylogram presenting the genetic relationships within and outside sect. *Aureocistophili* is shown in Figure 1. Sect. *Aureocistophili* was recovered in our analysis as a strongly supported monophyletic clade composed of nine species-level terminal clades. One of them is a North American species (Canada) not further treated in our study. All species are well delimited based on the ITS-LSU data.

Morphological characteristics and variation

Cortinarius sect. *Aureocistophili* is rather uniform in its morphological characters. The pileus of most species is initially pale (greyish) yellow, but turns rather vivid yellow-brown to red-brown (orange brown) with exposure and oxidation. Several species have abundant, silvery-frosty white veil remnants on the pileus, and the stipital bulb is often rather narrow, indistinctly margin-

ate and attenuate or at least longer than wide, often becoming vividly yellow-brown spotted. The spores are fairly small in all species (rarely >10 µm long), mostly ellipsoid (to subamygdaloid), but some species produce more pointed, amygdaloid-citriform spores. Laboratory photographs from our detailed examination of the spores of *Aureocistophili* species (see Methods above) are shown in Figure 2. The spore measurements are shown in Tables 1–2.

Table 1: Combined spore characteristics of the species of sect. *Aureocistophili*

Species	n coll.	n spec.	n spores	L×W (all) + MV; µm	L×W 95 %–variation w/ MV; µm	Q L/W (all) + MV	Q L/W 95%–variation w/ MV
Cortinarius xanthoochraceus	6	6	239	6.9–8.0–9.1 × 4.4–4.9–5.4	7.2–8.0–8.8 × 4.5–4.9–5.3	1.37–1.64–1.97	1.42–1.64–1.86
Cortinarius subrugulosus	2	2	70	7.2–8.2–9.1 × 5.0–5.3–5.9	7.4–8.2–9.0 × 4.9–5.3–5.7	1.35–1.53–1.72	1.37–1.53–1.68
Cortinarius fulminoides	4	4	197	7.1–8.3–9.5 × 4.7–5.4–6.3	7.3–8.3–9.3 × 4.8–5.4–6.0	1.25–1.55–1.91	1.33–1.55–1.77
Cortinarius mediterranensis	2	2	83	7.0–8.3–9.9 × 3.8–4.4–4.8	7.1–8.3–9.5 × 4.0–4.4–4.8	1.55–1.90–2.32	1.60–1.90–2.20
Cortinarius inusitatus				8.8–9.2–10.8 × 4.5–5.1.–5.6 [1]		1.60–1.80–1.96 [1]	
Cortinarius aureocistophilus				(7.3)–7.9–8.5–9.2–(10.4) × (4.2)–4.4–4.8.–5.0–(5.3) [2]		1.64–1.80–1.97 [2]	
Cortinarius spec. (*C.* aff. *inusitatus* in Fig. 1)	1	1	31	7.4–8.3–9.0 × 4.8–5.1–5.3	7.5–8.3–9.1 × 4.9–5.1–5.3	1.49–1.63–1.78	1.49–1.63–1.77
Cortinarius kytoevuorii Holotypus	1	1	50	7.5–8.5–9.6 × 4.6–5.2–5.9	7.5–8.5–9.5 × 4.6–5.2–5.8	1.48–1.64–1.88	1.46–1.64–1.82
[1] acc. Ortega et al. 2009 [2] acc. Vila 2007							

Most species are more or less xerothermous, while three of them are preferentially Mediterranean. Two occur exclusively in Mediterranean *Cistus* or sclerophyll *Quercus* vegetation. Two of the three coniferous forest species seem restricted mainly to the C European *Abies-Picea* area, with just a few outposts in the boreal forest belt. One coniferous forest species (*C. kytoevuorii*) is known only from the type (Finland). Most species are extremely rare, and apart from *C. xanthoochraceus*, none is known from more than 10 localities.

Phylogenetic and morphological relationships

The *Aureocistophilus* clade is well-supported phylogenetically, based on ITS studies (Fernández-Brime, 2014), and on multi-gene studies (Soop et al., 2019). Morphologically, the group is also well defined, as discussed above, and was therefore introduced formally as *Cortinarius* sect. *Aureocistophili* in Soop et al. (2019). In multi-gene phylogenies, it groups among a number of lineages with innate-fibrillose pileus with a duplex structure and with rather small, and rather densely verrucose spores. The section is related to e.g. sect. *Glaucopodes*, but detailed relationships are still not fully resolved (Soop et al., 2019). *Glaucopodes* taxa are morphologically

similar, but initially present a bluish-violet-olive and less vividly yellowish coloration, and they often possess a coarser innate-fibrillose structure of the pileus. In both sections the spores are relatively small and ellipsoid-amygdaloid, but tend more towards a citriform shape in *Aureocistophili*. The species of another related clade, Dionysae, are distinguished by the farinaceous smell, more regularly and pronounced innate-fibrillose pileus structure, and distinctly amygdaloid-citriform spores.

Table 2: Spore characteristics (single collections) of the species of sect. *Aureocistophili*

Species	Voucher	Country	n spo-res	L×W (all) + MV; µm	L×W 95 %–variation w/ MV; µm	Q L/W (all) + MV	Q L/W 95%–varia-tion w/ MV
Cortinarius xanthoochraceus	KS-CO60/GB KJ421016	Belgium	34	7.5–8.2–8.9 × 4.4–4.8–5.1	7.5–8.2–8.9 × 4.4–4.8–5.1	1.57–1.72–1.97	1.54–1.72–1.90
Cortinarius xanthoochraceus	KS-CO1169/GB KJ421017	Italy	33	6.9–7.9–8.4 × 4.6–4.9–5.3	7.1–7.9–8.7 × 4.5–4.9–5.3	1.44–1.59–1.71	1.45–1.59–1.73
*Cortinarius xanthoochraceus**	JA2709201502/ DNA1154	Germany	33	7.3–8.1–8.8 × 4.4–5.0–5.3	7.3–8.1–8.9 × 4.6–5.0–5.4	1.42–1.62–1.83	1.44–1.62–1.80
*Cortinarius xanthoochraceus**	SSt07-176/ DNA1159	Germany	54	7.5–8.1–8.8 × 4.5–4.9–5.4	7.5–8.1–8.7 × 4.5–4.9–5.3	1.50–1.66–1.82	1.50–1.66–1.82
*Cortinarius xanthoochraceus**	SSt16-137/ DNA1276	Germany	30	7.7–8.2–8.9 × 4.3–4.7–4.9	7.6–8.2–8.8 × 4.3–4.7–5.1	1.64–1.76–1.85	1.66–1.76–1.84
*Cortinarius xanthoochraceus**	SSt08-111	Germany	55	7.0–7.8–9.1 × 4.6–5.0–5.4	7.0–7.8–8.6 × 4.6–5.0–5.4	1.37–1.56–1.76	1.38–1.56–1.74
*C. subrugulosus**	CR5882-2017	Italy	39	7.2–8.1–9.0 × 5.0–5.2–5.6	7.3–8.1–8.9 × 4.8–5.2–5.6	1.38–1.54–1.72	1.40–1.54–1.68
C. subrugulosus	KS-CO901/GB KJ421054	Schweden	31	7.7–8.3–9.1 × 5.0–5.5–5.9	7.5–8.3–9.1 × 5.1–5.5–5.9	1.35–1.51–1.71	1.35–1.51–1.67
*C. fulminoides**	TG2012-054	Italy	31	7.1–7.8–8.4 × 4.9–5.2–5.5	7.2–7.8–8.4 × 5.0–5.2–5.4	1.36–1.51–1.70	1.37–1.51–1.65
*C. fulminoides**	MD2017-25	Germany	55	7.2–7.9–9.1 × 5.0–5.4–6.0	7.1–7.9–8.7 × 5.0–5.2–5.8	1.25–1.47–1.75	1.31–1.47–1.63
*C. fulminoides**	SSt08-072	France	56	7.8–8.7–9.5 × 5.2–5.7–6.3	7.9–8.7–9.5 × 5.3–5.7–6.1	1.40–1.54–1.74	1.36–1.54–1.72
*C. fulminoides**	SSt17-180	Germany	55	7.3–8.4–9.2 × 4.7–5.1–5.6	7.4–8.4–9.4 × 4.7–5.1–5.5	1.41–1.65–1.91	1.45–1.65–1.85
*Cortinarius mediterraneensis**	JK-Cort 06102301	Germany	39	7.2–8.1–8.8 × 4.2–4.5–4.8	7.1–8.1–9.1 × 4.1–4.5.–4.9	1.55–1.80–2.01	1.60–1.80–2.00
*Cortinarius mediterraneensis**	DB5963	Italy	44	7.0–8.4–9.9 × 3.8–4.3–4.6	7.2–8.4–9.6 × 3.9–4.3–4.7	1.73–1.99–2.32	1.71–1.99–2.27
*Cortinarius mediterraneensis**	Lu2119	Germany		8.5–10.5 × 4.5–5.0 [1]			
Cortinarius mediterraneensis		France		7.2–8.6–9.5 × 4.2–4.8–5.4 [2]		1.60–1.82–2.00 [2]	
C. inusitatus		Spain		8.8–9.2–10.8 × 4.5–5.1.–5.6 [3]		1.60–1.80–1.96 [3]	
Cortinarius aureocistophilus		Italy		(7.3)–7.9–8.5–9.2–(10.4) × (4.2)–4.4–4.8.–5.0–(5.3) [4]		1.64–1.80–1.97 [4]	
C. spec. (*C.* aff. *inusitatus* in Fig. 1)	TUB 019781	Germany	31	7.4–8.3–9.0 × 4.8–5.1–5.3	7.5–8.3–9.1 × 4.9–5.1–5.3	1.49–1.63–1.78	1.49–1.63–1.77
Cortinarius kytoevuorii	holotype/ KF732529	Finland	50	7.5–8.5–9.6 × 4.6–5.2–5.9	7.5–8.5–9.5 × 4.6–5.2–5.8	1.48–1.64–1.88	1.46–1.64–1.82
Cortinarius kytoevuorii	holotype/ KF732529			7.5–8.5–9.5 × 5.0–5.3–5.4 [5]		1.54–1.61–1.72 [5]	

* new sequences in this paper

[1] acc. Ludwig 2017
[2] acc. Fernández-Brime 2014
[3] acc. Ortega et al. 2009
[4] acc. Vila 2007
[5] acc. Liimatainen et al. 2014

Taxonomy

Cortinarius sect. ***Aureocistophili*** Soop, B. Oertel & Dima (2019)

MycoBank: MB822934.

Typus: *C. aureocistophilus* Vila, Contu & Llimona.

Currently identified members of the section

C. aureocistophilus
C. fulminoides
C. inusitatus
C. kytoevuorii
C. mediterraneensis
C. subrugulosus
C. xanthoochraceus
C. spec. (*C*. aff. *inusitatus* in Fig. 1)

Principal characters

The protologue (Soop et al., 2019) states:

Basidiomata medium-sized to large, evoking species of both sect. *Multiformes* and sect. *Glaucopodes*. Pileus 30–120 mm diam., viscid, yellow to orange or ochraceous, rarely violaceous when young, finely to coarsely white fibrillose, often with veil remnants near margin. Lamellae greyish white, rarely with a pink tinge. Stipe cylindrical with a rounded or marginate bulb, white, often flushing yellow with age. Veil white to yellowish, rarely with a blue tinge, sparse to rather copious. Context white, often flushing yellow with age or manipulation. Alkaline reaction reddish to brownish on pileus, or insignificant. Spores ellipsoid to amygdaloid, 7.5–11 × 4.5–6 μm, moderately verrucose. Mainly in *Picea*, *Abies*, *Fagus,* and *Quercus* forests, Europe.

Comments: One notes that the alkaline reaction is often reddish, which can be used as a differential character against sect. *Multiformes*. The near absence of violet tones on the lamellae may be used to differentiate most species in sect. *Glaucopodes*, which may otherwise mimic *Aureocistophili* due to the frequent presence of pale veil remnants on the pileus.

Cortinarius aureocistophilus Vila, Contu & Llimona

Original publication: *Rev. Catal. Micol.* 28: 173 (2006).

MycoBank: MB510913.

Typus: SCM B-5145 (Holotype), Spain, with *Cistus albidus* and *Cistus monspeliensis*.

Illustrations*: Fungi non delineati* XLI–XLII, *Cortinarius* Ibero-insulares 1:123.

Short description (based on the protologue and on Ballarà et al., 2007)

Pileus: –45 mm, plane to slightly depressed, margin straight or somewhat involute, cutis somewhat viscid in humid weather, colour ± uniform orange-yellow, lion yellow with a reddish tone, finely fibrillose at the margin. *Lamellae* adnate to notched, rather crowded, yellow-brown or pale brown, edge concolorous or slightly paler, irregular or finely serrated, with lamellula. *Stipe* 35 × 10 mm, cylindrical, tapering at the base, concolorous with the pileus, base whitish, silky. *Context* fairly compact, whitish to pale yellow, faintly brownish. *Odour* insignificant.

Spores: (7.3–) 7.9–9.2 (–10.4) × (4.2–) 4.4–5.0 (–5.3) μm (MV = 8.5 × 4.8 μm), rather narrowly amygdaloid (to more ellipsoid), moderately verrucose. *Basidia* 4-spored. *Lamellar* edge fertile. *Pileipellis* of 2–6.5 μm wide, gelatinous hyphae at surface.

Habitat: On relatively acid soil (siliceous, not calcareous rocks), with *Cistus* (mainly *Cistus monspeliensis*), Southern Europe (Spain, Italy).

Comments: *Cortinarius aureocistophilus* is so far apparently known only from two localities at Girona, Spain and one in Sardinia, Italy (Fernández-Brime et al., 2014). The species was described by Vila and Llimona (2006) with a Latin diagnosis, and the diagnosis was subsequently published in Spanish, with some additional information, including pictures of the basidiomata and spores in Ballarà et al. (2007). The spore measurements deviate considerably between the protologue and Ballarà et al. (2007), and we have based our description of spores on the latter (which seem to include more material). So far, only the type and the second collection from Girona have been sequenced.

According to the protologue and the picture of the type in Ballarà et al (2007), the species has a characteristic, only very weakly marginate, more or less attenuate bulb, resembling that of *C. olidoamarus*. This distinguishes the species from related taxa, although *C. mediterraneensis* and *C. inusitatus* might also possess a rather narrow and pointed bulb. Furthermore, the pileus presents a uniform, vivid orange-yellow colour, which could be due to oxidation, especially as the stipe and context have vividly saffron yellow spots, partly from bruising. The KOH reaction was not noted in the protologue, but indicated as negative in Vila (2007), contrasting that given for the related *C. inusitatus* (orange). Here also more material is probably needed to confirm these differences. The spores of *C. aureocistophilus* are somewhat smaller than those of *C. inusitatus*. The attenuated stipe and the small, lion-yellow to orange-yellow pileus seem to be the dominant differential characters of the former, along with the growth with *Cistus*. It should, however, be noted that most *Phlegmacium* species found under *Cistus* are also able to associate with *Helianthemum* and deciduous trees, such as *C. cisticola* (cf. e.g. Liimatainen & Ainsworth, 2018). So, one cannot exclude the possibility that *C. aureocistophilus* also occurs under evergreen *Quercus* species, especially in areas of transition to open macchia scrubland.

According to present knowledge, *C. aureocistophilus* is, together with the related *C. inusitatus*, one of few phlegmacioid species that appear to be restricted to the Mediterranean vegetation zone. This pattern we see also in *C. caligatus*, *C. variiformis* s. str. and the calochroid-fulvoid *C. murellensis*, of which at least *C. variiformis* grows with *Cistus* (cf. e.g. Ballarà et al., 2007). Most other southern, xerothermous Phlegmacia have outpost localities in submediterranean *Quercus cerris–Q. pubescens* vegetation, as well as sometimes in warm *Fagus* forests. *Cortinarius mediterraneensis*, *C. ionochlorus*, *C. splendificus*, and *C. humolens* are examples of this distribution pattern (see distribution map of *C. humolens* in Brandrud, 2000).

Cortinarius fulminoides (M. M. Moser) M. M. Moser **Fig. 3, 4**

Original publication: *Kl. Krypt.-Fl.*, Edn 3, 2b/2, p. 284 (1967).

MycoBank: MB452908.

Basionym: *Phlegmacium fulminoides* M. M. Moser (1960).

Typus: Tyrol, Austria. In coniferous forests.

Illustrations: Dähnke (1993), Münzmay et al. (2009), Soop (2018).

Pileus: 35–60 (–80) mm, rounded then convex-expanded, viscid, not or weakly hygrophanous, dark yellow-brown, red-brown to apricot yellow, glabrous to finely innate-fibrillose, margin pale yellow with paler veil remnants. *Lamellae* greyish white when young, crowded (L = 94, l = 1–2). *Stipe* 40–50 × 19–23 mm, cylindrical with a slightly marginate-rounded bulb (–28 mm), white.

Veil yellowish, sparse; *cortina* white. *Context* white, faintly marbled grey-brown. *Odour* insignificant; *taste* strong, unpleasant.

Macrochemical reactions: NaOH reddish on the cap.

Spores: [4, 4, 197], 7.3–9.3 × 4.8–6.0 µm, MV = 8.3 × 5.4 µm, variation of MVs = 7.8–8.7 × 5.1–5.7 µm, Q = 1.33–1.77, Q_{MV} = 1.55, variation of Q_{MV}: 1.47–1.65 µm, usually ellipsoid, seldom slightly amygdaloid, fairly to strongly verrucose especially at apex. *Basidia* 4-spored, 25–30 × 7–9 µm. *Marginal elements* short, 13–22 × 5–6 µm, clavate. *Pileipellis* (Münzmay et al., 2009) duplex, sparingly gelified of hyaline or golden-brown hyphae, 1–5 µm wide**.** *Epicutis hyphae* 2–5 µm wide. *Hypoderm* elements robust with a yellow, parietal pigmentation.

Photo: Geert Schmidt-Stohn

Fig. 3 — ***Cortinarius fulminoides***
(Germany, Thüringen, Bachfeld, Stelzener Berg, SSt17-180)

Habitat: In calcareous, coniferous forests, central and southern Europe.

Collections studied: Germany. 17.10.2005, Löffingen TK 8015/4 in *Abies alba*-dominated coniferous forest, calcareous, D. Knoch GS-171005-1; 30.09.2007, Oberjoch, TK 8428/4, with *Picea* (and *Abies*?) on calcareous soil, S. Garnica TUB 011559; 22.09.2007, Hohenfelden/Erfurt, TK 5132/2, with *Picea* on calcareous soil, J. Girwert GS-220907-1, 03.10.2017, Thüringen, Bachfeld, Stelzener Berg TK 5531.4.2.4, calcareous *Picea* forest, G. Schmidt-Stohn SSt17-180; 07.09.2017, Bayern, Wackersberg, Zwieselberg, TK 8234.4.4.2, mixed forest with *Picea*, *Abies*, *Fagus*, M. Dondl MD2017-25; **France**. 06.10.2008, Prénovel, calcareous *Picea* (*Abies*?) forest, G. Schmidt-Stohn SSt08-072; 07.10.2008 Prénovel, coniferous wood, calcareous, G. Saar GS-071008-1; **Italy**. 18.08.2012, Val Badia-Longiaru, G. Turrini TG2012-054; **Switzerland**. Schwarzenburg, 17.09.2012, in mixed *Abies-Fagus* forest, K. Soop CO2080.

Comments: This fungus resembles *C. multiformis* and some taxa in section *Calochroi* s. lato, such as *C. napus, C. pseudonapus,* and *C. kristinae,* but is distinguished from the latter by a duplex pileipellis with thin epicutis. From the former the species is distinguished e.g. on the more

strongly ornamented spores and the lack of a honey smell. *C. subrugulosus* has more abundant and paler, silvery-fibrillose veil remnants on the pileus. *C. xanthoochraceus* has a paler, more ochre yellow pileus, and grows with broad-leaf trees.

Photo: Geert Schmidt-Stohn

Fig. 4 — ***Cortinarius fulminoides***
(France, Prénovel, SSt08-072)

Cortinarius fulminoides is a rare species, found mainly on calcareous soils in the montane mixed *Abies alba* forest regions of the Prealps, the Jura, and the Black Forest, often together with other dominant *Abies* associates. It thus seems to belong to this element of calciphilous *Phlegmacium* species, preferentially associated with *Abies*, such as *C. atrovirens, C. citrinoolivaceus, C. haasii* and *C. subgracilis*. However, its habitat preferences are still poorly known. Apparently, it can also grow in pure *Picea abies* stands in C Europe (see collection list). In the Pyrenees, it is reported from *Pinus sylvestris* forests (Ballarà et al., 2007).

Cortinarius inusitatus A. Ortega, Bidaud, Suárez-Santiago & Vila **Fig. 5**

Original publication: *Fungal Diversity,* 36, p. 91–94 (2009).

MycoBank: MB512101.

Typus: GDA 53699 (Holotype). Spain, Granada, Sierra de Huétor Natural Park, with *Quercus.*

Illustrations: Ortega (2009).

Short description (based on the protologue)

Pileus: 40–120 mm, initially reddish brown violet or greyish violet, with yellowish olive hues towards the margin, later turning greyish pink to greyish orange brown. *Lamellae* crowded, adnate, sinuate or emarginate, whitish with bluish (greyish pink) hues, edges slightly paler. *Stipe*

30–100 × 20–30 mm, with an evident but scarcely marginate bulb (26–40 mm), whitish with a slight pinkish-bluish tinges when young. *Veil* abundant, white, with bluish and/or greyish orange hues, flavescent in older specimens, breaking into numerous cream pink or cream yellow, membranous patches or scales on the pileus and bulb surface. *Cortina* a cream pink shade. *Context* whitish, but yellow in older and damaged specimens. *Odour* and *taste* not distinctive.

Macrochemical reactions: KOH (30 %) brick red or reddish brown on cap and stipe surface, yellowish orange in context.

Spores: 8.8–10.8 × 4.5–5.6 µm, MV = 9.2 × 5.1 µm, Q = 1.60–1.96, Q_{MV} = 1.80 µm (acc. Ortega et al., 2009), ellipsoid, subamygdaloid to amygdaloid, moderately verrucose. *Basidia* 4-spored, 25–40 × 8–100 µm. *Marginal elements* sparse, 7–10 µm wide, clavate to cylindrical. *Pileipellis* duplex, of gelified 2–4 µm wide, hyaline or ± yellow hyphae. *Hypoderm* elements 8–22 µm wide with a yellowish, vacuolar and parietal pigmentation. *Veil hyphae* 2.5–5 µm wide.

Habitat: In sclerophyll Mediterranean oak forests and *Cistus* shrubs, under *Q. rotundifolia* and *C. laurifolius*, recorded in the Iberian Peninsula.

Photo: Günter Saar

Fig. 5 — ***Cortinarius*** spec. («*C.* aff. *inusitatus* in Fig. 1»)
(Germany, Ebringen, Schönberg, GS 8423 BM)

Comments: This is, with our new *Cortinarius* spec. (see below), the only member of the section with bluish tints on the basidiomata. However, as in the related sect. *Glaucopodes*, the bluish tinges are fugacious, and when mature, the fungus can easily resemble the non-bluish relatives, *C. aureocistophilus* and *C. mediterraneensis*. *C. inusitatus* and *C. aureocistophilus* may co-occur in *Cistus* vegetation, and may apparently be rather similar when mature, both developing warm orange-brown pileal colours. *C. aureocistophilus* seems to possess a narrower, attenuate stipe base (almost non-marginate), but more material is needed to see if this is always the case. The spores of the two species are quite similar, but those of *C. inusitatus* (MV = 9.2 × 5.1 µm) are apparently slightly larger on average than those of *C. aureocistophilus* (MV = 8.5 × 4.8 µm), but also here more data are needed to confirm this subtle difference.

Cortinarius kytoevuorii Niskanen & Liimat.

Original publication: *Persoonia,* 32, p. 124 (2014).

MycoBank: MB805865.

Typus: H 6029355 (Holotype). Finland. Koillismaa, Kuusamo, on calcareous soil in *Picea abies* forest with *Betula*, *Pinus sylvestris* and *Populus tremula*.

Illustrations: Liimatainen et al. (2014).

Short description (based on the protologue)

Pileus: 60–90 mm, finely innate-fibrillose, yellow-brown to brown, with hygrophanous streaks. *Lamellae* emarginate, crowded to medium spaced, at first pale (brownish) grey. *Stipe* 60–90 × 12–15 mm, 20–25 mm wide at base, with a fairly narrow, marginate bulb, at first white, becoming pale brownish yellow with age. *Context* whitish to pale yellow. *Odour* indistinct.

Macrochemical reactions: KOH in pileipellis brown (no reddish tints); in context, mycelium, and bulb margin negative.

Spores: [1, 1, 50], 7.5–9.5 × 4.6–5.8 µm, MV = 8.5 × 5.2 µm, Q = 1.46–1.82, Q_{MV} = 1.64, ellipsoid (exceptionally slightly amygdaloid), strongly verrucose, slightly to moderately dextrinoid. *Basidia* 4-spored, 24–32 × 7.5–9 µm. *Epicutis* of orange, weakly gelatinous, hyphae, 5–10 µm wide, finely to strongly incrusted, with intercellular orange-red granules. *Hypocutis* elements large, yellowish.

Habitat: In coniferous forests (*Picea, Pinus*) on calcareous soil, recorded in NE Finland (Kuusamo).

Comments: *Cortinarius kytoevuorii* is so far only known from the type material. According to the protologue, it is reminiscent of *C. glaucopus* but is more slender with a narrow bulb, has a yellow brown to brown pileus, and lacks bluish tints in basidiomata. It is furthermore said to be recognised by the orange-red granules and concretions in the uppermost hyphae of the pileipellis (seen with Melzer's reagent). However, the same character is more or less present in the sister species *C. subrugulosus*, but is so far not investigated in other species of the section. Based on photo and description in the protologue, *C. kytoevuorii*, possesses the same, vivid yellow-brown-orange brown pileus colours as seen in the sister species *C. subrugulosus*. Both have also very similar, ellipsoid spores. Conclusively, taking the scanty material of *C. kytoevuorii* available at present into account, the two taxa may be regarded as cryptic species.

We examined the spores of the holotype and our values are in very good agreement with the protologue. But we found that none of the spores was clearly amygdaloid. Moreover, the line drawings of the spores in the protologue are in contradiction to the given L-, W- and L/W-values.

Cortinarius mediterraneensis A. Ortega & Vila **Fig. 6, 7**

Original publication: *Mycologia,* 106 (3), p. 494 (2014).

MycoBank: MB805897.

Typus: IB 1980618 (Holotype). France, Porquerolles, under *Pinus*. *C. talus* Fr. s. Esteve Raventós et al. (2007).

Illustrations: Fernández-Brime et al. (2014), Ludwig (2017).

Pileus: 30–90 mm, rounded then convex-expanded with a shallow umbo, viscid, not hygrophanous, when young yellowish grey or pale ochraceous yellow, becoming more fulvous red-brown from centre with age or exposure, glabrous or finely innate fibrillose when young with a few fibril-

lose, silvery-white to yellowish veil patches, sometimes even whitish fibrillose to frosty at centre, margin concolorous. *Lamellae* white to (yellowish) grey when young, moderately crowded (L=64, l=2), adnate, edge concolorous. *Stipe* 30–100 × 9–22 mm, with a rounded to distinctly marginate, sometimes attenuate and pointed bulb, white, flavescent on handling, bulb margin with initially volva-like, white veil remnants, becoming yellow-brown. *Veil* white, turning yellow to yellow-brown, sparse on pileus, abundant on bulb margin when young; *cortina* not noted. *Context* white, faintly yellow tinged in stipe apex, ± flavescent on exposure. *Odour* faint, fruity or like bakery; *taste* insignificant, apart from a bitter cutis.

Macrochemical reactions: KOH yellowish on pileus, reddish on bulb margin. Guayac and $AgNO_3$ negative.

Microscopic characters (partly from protologue).

Spores: according to protologue: 7.2–9.5 × 4.2–5.4 µm, variation of MVs = 8.2–8.9 × 4.6–5.0 µm, Q = 1,75–1.79, amygdaloid-citriform; own measurement of collections from Berlin/Leipzig and Milan: [2, 2, 83], 7.1–9.5 × 4.0–4.8 µm, MV = 8.3 × 4.4 µm, variation of MVs = 8.1–8.4 × 4.3–4.5 µm, Q = 1.60–2.20, Q_{MV} = 1.90, variation of Q_{MV}: 1.80–1.99 µm, narrowly amygdaloid (fusoid), subcitriform to citriform, usually with a more or less distinct suprahilar depression, moderately to fairly coarsely verrucose. *Pileipellis* duplex. *Epicutis* thick, the upper layer slightly or moderately gelatinous hyphae, 2–5 µm wide with cylindrical, enlarged or claviform terminal cells, and a yellowish ochraceous vacuolar and incrusted pigment; the lower layer of interwoven, repent hyphae, with yellowish ochraceous incrusted pigment. *Hypoderm* a dense interwoven repent layer of hyphae, 8–22 µm wide with yellowish ochraceous, vacuolar and incrusted pigment. *Veil hyphae* 7 µm wide, hyaline or yellowish.

Photo: Jesko Kleine

Fig. 6 — ***Cortinarius mediterraneensis***
(Germany, Sachsen, Leipzig, JK Cort06102301)

Habitat: On calcareous or siliceous ground, with *Pinus halepensis* and evergreen *Quercus ilex* and *Q. rotundifolia* (southern Europe), also with *Tilia* (Italy) and *Fagus-Quercus* (Germany). The Italian and German finds are from secondary park-road border localities. So far known from Mediterranean regions of Spain and S France, and a few northern outposts in N Italy (Milan) and Germany (Berlin, Leipzig). Ludwig (2017) indicates a wider distribution in Germany, but this information is based on non-sequenced material, and should be regarded as unverified.

Collections studied: Germany. 23.10.2006, Sachsen, Leipzig, J. Kleine JK-Cort 06102301: 30.10.1989, Berlin-Tegel, E. Ludwig 2119; **Italy**. 25.10.2015, Vernate. Milan south, park with *Tilia*, L. & G. Miste, DB5963/TEB730-15; **Spain**. 25.10.2015, Castelló, Morella, Villafranca, in *Quercus ilex* copse, *K. Soop* CO1600.

Photo: Jesko Kleine

Fig. 7 — ***Cortinarius mediterraneensis***
(Germany, Sachsen, Leipzig, JK Cort06102302)

Comments: *Cortinarius mediterraneensis* is characterized by an ochraceous (grey-)yellow pileus, soon becoming fulvous red-brown from centre due to oxidation (when exposed in ± open habitats), with a rather narrow (slightly marginate) bulb and small amygdaloid-citriform spores. These features are, however, quite similar to those of the related, Mediterranean species *C. aureocistophilus*. According to material seen so far, the latter seems to be a smaller species with only a very weakly developed, attenuate bulb, and with more amygdaloid (hardly citriform) spores. It should be noted that in our measurements of collections from Milan and Berlin, the spores are more narrow than those from Mediterranean collections in the protologue of Fernández-Brime et al. (2014). The third Mediterranean species in the clade, *C. inusitatus*, is distinguished by its initially bluish tinges on pileus and lamellae. When mature, these species could be very similar, although the spores are slightly larger in *C. inusitatus*. When non-oxidized and ochraceous yellow, the basidiomata also resemble those of the *Fagus* associate *C. xanthoochraceus*, but the latter is distinguished by distinct veil patches on the pileus surface, and by its smaller, more ellipsoid spores.

Cortinarius subrugulosus Bidaud & Armada **Fig. 8, 9**

Original publication: *Atl. des Cort*., 16, p. 1096 (2006).

MycoBank: MB529640.

Typus: PC Bidaud 05-10-263 (Holotype), France, on calcareous soil in coniferous forests.

Synonyms:

C. glaucopus var. *acyaneus* (M. M. Moser) Nezdojm (1963).

C. parherpeticus Rob. Henry s. Soop (2014).

C. subfuligineus Bidaud in Bidaud et al. (2008).

Illustrations: Marchand (1982) as *C. parherpeticus*, Bidaud et al. (2006, 2008), Soop (2018).

Pileus: 30–120 mm, rounded then convex-expanded, viscid soon drying, not hygrophanous or sometimes with a hygrophanous margin, warm ochraceous yellow, later with silvery white to pale yellow patches from veil remnants, often coarsely to finely greyish innate-fibrillose, margin grey-white with white fibrils. *Lamellae* white to pale greyish when young, rarely with a faint violet tinge, crowded (L = 78–112, l = 1–2). *Stipe* 30–125 × 11–25 mm, with a rounded to distinctly marginate bulb (–33 mm), robust, white, turning more or less yellowish towards base when older, bulb margin with a white coating. *Veil* at bulb margin white, flavescent, sparse to rather copious; *cortina* whitish. *Context* white to pale greyish yellow, turning vividly saffron-yellow when damaged by insects. *Odour* faint, fruity; *taste* insignificant.

Macrochemical reactions: NaOH and KOH yellow-brown in context, red-brown on cutis and in the bulb, nil on stipital veil; guayac green; phenol insignificant.

Photo: Claudio Rossi

Fig. 8 — ***Cortinarius subrugulosus***
(Italy, Bolzano, Dobbiaco Grand Hotel, CR 5882-2017)

Spores: [2, 2, 70], 7.4–9.0 × 4.9–5.7 µm, MV = 8.2 × 5.3 µm, variation of MVs = 8.1–8.3 × 5.2–5.5 µm, Q = 1.37–1.68, Q_{MV} = 1.53, variation of Q_{MV}: 1.51–1.54 µm, ellipsoid, sometimes slightly amygdaloid with a slight suprahilar depression, rather strongly verrucose. *Basidia*

4-spored, 26–30 × 5–7 µm. *Marginal elements* 20–30 × 5–7 µm, ellipsoid to vesiculose. *Pileipellis* gelified, repent hyphae 3–7 µm wide, pale yellow. *Hypocutis* elements elliptic, yellow-brown.

Photo: Bálint Dima

Fig. 9 — ***Cortinarius subrugulosus***
(Spain, Castelló, Morella, Mas de la Carcellera, El Bovalar, DB2210)

Habitat: In calcareous *Abies*, *Picea* and *Pinus* forests. Known from Central Europe (Prealps, Jura) and E Spain, with some outposts in SE and C Sweden.

Collections studied: Italy. 28.09.2017, Bolzano, Dobbiaco Grand Hotel, calc. *Picea(-Abies?)* forest, C. Rossi CR5882-2017; **Spain**. 26.10.2005, Castelló, Morella, Mas de la Carcellera, El Bovalar, under *Pinus nigra*, in calcareous soil, B. Dima, T. Niskanen, K. Liimatainen DB2210. **Sweden**. 15.10.1997, Uppland, Fårskär, in calcareous *Picea* forest, K. Soop CO901; 06.10.2006, Uppland, Älvkarleby, Biludden, Rullsand, T. E. Brandrud, H. Lindström, H. Marklund, J. Melot, TEB 257-06, TEB 258-06; 17.09.2014, Dalarna, Rättviksheden, in calcareous *Picea* forest, K. Soop CO2156; 20.09.2011, Gotland, Visby N, Brucebo, calcareous *Pinus* forest (on sand), T. E. Brandrud, T. S. Jeppesen, T. G. Frøslev, TEB 1070-11.

Comments: *Cortinarius subrugulosus* is characterized by the silvery patches from veil remnants at pileus centre, and the warm ochraceous yellow pileus colours. The species might resemble *C. glaucopus*, but is normally devoid of violet tones, and the pileus is paler, more yellow, and with pronounced veil patches. In addition, the spores are slightly wider. It is distinguished from the potentially co-occurring *C. fulminoides* by the paler pileus with veil patches.

This is, with *C. fulminoides* and *C. kytoevuorii,* the only coniferous forest species within sect. *Aureocistophili*. The species is recorded under various conifer trees, but seems to have a major distribution in the montane *Abies-Picea* forest zone of Central Europe, recorded from Austria (Tyrol; Moser, 1960 as *C. glaucopus* var. *acyaneus*), N Italy (leg. C. Rossi) and E France (Bidaud et al., 2006). Furthermore, the species is recorded by us under *Pinus nigra* in E Spain and under *Pinus sylvestris* and *Picea abies* in SE and C Sweden (see collection list). According

to Liimatainen et al. (2014) it was also once collected in a *Fagus* forests with some conifer trees (Sweden, Öland). The collections under *Pinus* are from rather open, xerothermous forests, including a Mediterranean *Pinus nigra* site in E Spain.

Cortinarius xanthoochraceus P. D. Orton **Fig. 10, 11**

Original publication: *Trans. Br. mycol. Soc.,* 43 (2), p. 216 (1960).

MycoBank: MB543784.

Typus: K(M) 109652 (Holotype). Great Britain. In beech wood on chalk soil.

Synonyms:

C. allutus Fr. s. auct. p.p.
C. aurantiotinctus Bidaud in Bidaud et al. (2001).
C. fallacecolor Rob. Henry (1981) p. p. nom. inval.
C. langei Rob. Henry s. Orton (1955), Soop (2005).
C. rapaceus Fr. s. Soop (1998).

Illustrations: Münzmay & Saar (2005), Bidaud et al. (2006), Brandrud & Schmidt-Stohn (2011), Soop (2018), Deneyer (2017) as *C. langei.*

Pileus: 45–90 mm, obtusely rounded, then convex-expanded, often with a shallow umbo, viscid, not hygrophanous, or with hygrophanous spots or a zone near margin, initially pale greyish yellow with a honey-yellow tinge, with age more ochraceous to golden brown from centre, long frosty white, often with silvery white patches from abundant veil remnants, glabrous to finely innate-fibrillose, margin concolorous, finely fibrillose. *Lamellae* pale grey to greyish white when young, soon brownish grey; very crowded (L=114–120, l=2) and narrow (4 mm), free, edge concolorous. *Stipe* 30–50 × 9–18 mm, with a more or less distinctly marginate bulb (–30 mm), white, bulb-margin staining yellow brown. *Veil* white, fairly sparse; *cortina* white. *Context* white, later creamy, somewhat marbled ochraceous, staining ± yellow-brown where damaged by insects. *Odour* faint, sometimes honey-like in bulb context; *taste* insignificant.

Macrochemical reactions: KOH in context yellow-ochre, formalin insignificant.

Spores: [6, 6, 239], 7.2–8.8 × 4.5–5.3 µm, MV = 8.0 × 4.9 µm, variation of MVs = 7.8–8.2 × 4.7–5.0 µm, Q = 1.42–1.86, Q_{MV} = 1.64, variation of Q_{MV}: 1.59–1.76 µm, ellipsoid to slightly amygdaloid, sometimes with suprahilar depression, slightly to distinctly verrucose. *Basidia* 4-spored, 20–25 × 8 µm. *Marginal elements* short, 14–22 × 6–8 µm, clavate. *Pileipellis* (Münzmay & Saar, 2005) of gelified, pale yellow hyphae, 1–4 µm wide, lower strata 5–10 µm wide. *Hypoderm* elements subcellular, sparsely pigmented, 10–22 µm wide.

Habitat: In calcareous *Fagus* forests, often in rather deep leaf litter; once also collected under *Ostrya*, once also in a *Quercus*-*Carpinus*-*Tilia* habitat. Distributed mainly in nemoral/temperate parts of Europe from north of the Alps to southern Scandinavia.

Collections studied: Austria. 01.10.2003, Jerischach-Miklauzhof/Kärnten, under *Fagus*, T. Münzmay & G. Saar TK 8453; **Italy**. 13.10.2000, Kaltern, Castelfeder, pastoral meadow with Ostrya, K. Soop CO1169; **Belgium**. 15.10.1984, Brabant, Groenendaal, in *Fagus* copse, K. Soop CO60; 27.09.1986, Brabant, Parc de Tervuren, in *Fagus* copse, K. Soop CO177; 22.10.1990, idem, CO481; **Germany**. 27.09.2015, Nieders., Bad Fallingbostel, Böhmeschlucht, TK 3124.1 MF 08, with *Fagus*, B. Grauwinkel & J. Albers JA2709201502, 03.10.2007, Sachs.-Anh., Huy-Neinstedt, Huy, with *Fagus*, G. Schmidt-Stohn SSt07-176, 01.11.2016, Nieders., Ahlsburg, with *Fagus*, A. Schilling SSt16-137, 13.10.2008, Meckl.-Vorp., Rügen, Göhren, *Fagus*, G. Schmidt-Stohn SSt08-111. **Hungary**. 15.10.2004, Somogy County, Belső-Somogy, Nagybajom, under *Tilia*, *Carpinus*, and *Quercus*, B. Dima, L. Albert DB1392; 12.10.2014, Heves County, Mátra Mts, Parádóhuta, Pisztrángos-tó, under *Fagus*, B. Dima DB5610.

Photo: Geert Schmidt-Stohn

Fig. 10 — ***Cortinarius xanthoochraceus***
(Germany, Meckl.-Vorp., Rügen, Göhren, SSt08-111)

Photo: Geert Schmidt-Stohn

Fig. 11 — ***Cortinarius xanthoochraceus***
Germany, Sachs.-Anh., Huy-Neinstedt, Huy, SSt07-176)

Comments: The species resembles *Cortinarius talus* and *C. rhizophorus*, from which it differs mainly by the typical veil patches on the pileus. Furthermore, the former has a strong honey-like smell when cut, hardly becomes yellow-spotted, and the latter has a rounded, almost non-

marginate bulb, usually some ochraceous veil remnants on the lower half of stipe, and grows in a different habitat (mainly in *Quercus*-*Carpinus*-*Corylus* forests). *Cortinarius xanthoochraceus* differs from all other *Aureocistophili* taxa by its habitat in the leaf litter of closed *Fagus* forests.

Cortinarius sp. (*C.* aff. *inusitatus* in Fig. 1)

Pileus: –60 mm, greyish ochraceous with a violet tint in places, darkening on manipulation, radially fibrillose, disk with white veil remnants. *Lamellae* violaceous to pale brown, edge paler, medium crowded. *Stipe* –40 × 15 mm, with a marginate bulb, white with a lilac tint at apex, and a violet sheen on upper bulb surface, basal felt white, bulb flushing ochraceous on pressure. *Context* whitish cream, somewhat yellowish in stipe. *Odour* and *taste* insignificant.

Macrochemical reactions: KOH reddish brown on pileus, ochraceous in context, none on basal felt. Lugol yellow in context.

Spores: 8–10 × 4.7–6.0 µm, elliptic to amygdaloid, medium verrucose. *Lamellar edge* fertile, marginal cells insignificant. *Epicutis* an ixocutis of yellow (parietal) pigmented hyphae, 2–6 µm wide in upper strata, lower hyphae hyaline, hardly pigmented of same width. Lower strata of amorphous pigments in the border zone to the well-developed hypoderm.

Collections studied: 09.11.2004, Germany, Ebringen, Schönberg, with *Abies* and *Fagus*, G. Saar 8423, TUB 019781.

Comments: This fungus, only reported once, was recovered in the phylogram of Garnica et al. (2016) as a sister clade (*C. inusitatus* II) to *C. inusitatus*. In our phylogram, this taxon differs from the latter by seven substitutions and indel positions in the ITS region. Unfortunately the species was not found again, and the *Abies* trees were removed from the site two years ago. It is currently not known whether this taxon is a *Fagus* or an *Abies* symbiont.

Key to the species of the section

1 Pileus with blue to violet tones; with *Cistus* or sclerophyll *Quercus* ..... ***C. inusitatus***

1* Pileus yellowish, then vivid yellow-brown to red-brown, without bluish tones, with various hosts **2**

2 With coniferous hosts **3**

2* With frondose forest hosts (incl. *Pinus halepensis*) **5**

3 Pileus without or rarely with whitish veil patches..... ***C. fulminoides***

3* Pileus usually with distinct whitish veil patches **4**

4 Spores with $Q_{MV} < 1.55$, mainly C Europe (and C Sweden) ..... ***C. subrugulosus***

4* Spores with $Q_{MV} > 1.55$, so far only known from N Finland ..... ***C. kytoevuorii***

5(2) With *Fagus* or (rarely) *Quercus* (when spores slender, see also 6*)..... ..... ***C. xanthoochraceus***

5* Mainly in Mediterranean *Cistus*, evergreen *Quercus* or *Pinus halepensis* habitats **6**

6 Pileus <50 mm diam., stipe almost without a bulb, often tapering towards base with *Cistus* ..... ***C. aureocistophilus***

6* Pileus wider, stipe usually ± marginate bulbous, under *Pinus halepensis* and sclerophyll *Quercus spp,* also with broad-leaf trees in C Europe ..... ***C. mediterraneensis***

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