



# ‘Cort short on a mountaintop’ – Eight new species of sequestrate *Cortinarius* from sub-alpine Australia and affinities to sections within the genus

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## Key words

diversity  
systematics  
taxonomy  
*Thaxterogaster*

**Abstract** During the course of research on mammal mycophagy and movement in the Northern Tablelands of New South Wales, Australia, extensive collections of sequestrate fungi were made, including numerous cortinarioid taxa. Historically any novel taxa would have been described in the cortinarioid sequestrate genera *Descomyces*, *Hymenogaster*, *Protoglossum*, *Quadrispora*, *Thaxterogaster* or *Timgrovea* based on broad morphological similarities of the sporocarps and spore ornamentation. However, consistent with other recent analyses of nuclear DNA regions, taxa from sequestrate genera were found to have affinities with *Cortinarius* and *Descolea* or *Hebeloma*, and to be scattered across many sections within *Cortinarius*. None of the historical sequestrate cortinarioid genera are monophyletic in our analyses. In particular, the gastroid genus *Hymenogaster* is paraphyletic, with one clade including two species of *Protoglossum* in *Cortinarius*, and a second clade sister to *Hebeloma*. Eight new species of sequestrate *Cortinarius* are described and illustrated, and discussion of their affinities with various sections provided: *C. argyronius*, *C. caesibulga* and *C. cinereorseolus* in section *Purpurascentes*, *C. maculobulga* in section *Rozites*, *C. sinapivelus* in section *Splendidi*, *C. kaputarensis* in a mixed section *Phlegmacium/Myxacium* within a broader section *Dermocybe*, *C. basorapulus* in section *Percomes* and *C. nebulobrunneus* in section *Pseudotriumphantes*. Keys to genera of the *Bolbitiaceae* and *Cortinariaceae* containing sequestrate taxa and to currently known Australian species of sequestrate *Cortinarius* and *Protoglossum* are provided. As with the related agaricoid taxa, macroscopic characters such as colour and texture of basidioma, degree of localisation of the hymenophore, and stipe-columella development and form remain useful for distinguishing species, but are generally not so useful at the sectional level within *Cortinarius*. Microscopic characters such as spore shape, size, and ornamentation, and pileipellis structure (simplex vs duplex and size of hyphal elements) are essential for determining species, and also appear to follow sectional boundaries.

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## INTRODUCTION

*Cortinarius* is an important ectomycorrhizal genus, widely distributed in both hemispheres. It is one of the larger, taxonomically diverse genera of basidiomycetes, with approximately 2 000 species recognised worldwide (Kirk et al. 2001). *Cortinarius* species are highly variable in colour and form, though may be distinguished from other Agaricales by brown, ornamented spores and an inner cobweb (cortina) veil. Several genera of sequestrate fungi have at various times been shown to share these characters, and are known to have affinities to *Cortinarius* (Dodge & Zeller 1934, Singer 1951, Singer & Smith 1959, Bougher & Castellano 1993). The general characteristics distinguishing sequestrate genera from related agaric taxa are that the hymenophore remains enclosed by the pileus, the spores are not actively discharged, and the sporocarps are hypogaeal or emergent. As with many groups of sequestrate fungi, the taxonomy and nomenclature of the cortinarioid fungi is in a state of flux, with many genera proving to be paraphyletic based upon molecular evidence (Peintner et al. 2002a, Hosaka et al. 2006, Lebel & Tonkin 2008). A number of agaricoid and sequestrate genera have been incorporated into *Cortinarius*, for example the genus *Thaxterogaster* (Peintner et al. 2002b),

however the more gastroid taxa such as *Hymenogaster*, *Quadrispora* and *Protoglossum* have as yet to be transferred.

In Australia 11 genera and 39 species of sequestrate cortinarioid fungi have been fully described (Cunningham 1979, Beaton et al. 1984, Castellano & Trappe 1990, Bougher & Castellano 1993, May et al. 2003, Francis & Bougher 2003, 2004), and numerous DNA sequences made available for another 20–30 undescribed taxa (Francis 2007). During an extensive study of sequestrate fungi and mycophagy in the Northern Tablelands of New South Wales, a large number of new sequestrate taxa were discovered representing some 22 genera. The *Cortinariaceae* are a dominant component of the mycota, particularly of the sub-alpine zone. We present descriptions and illustrations of eight new species, and a key to currently described Australian sequestrate *Cortinarius* and *Protoglossum* species.

## MATERIALS AND METHODS

### Molecular analyses

#### Taxon sampling

The regions of nuclear ribosomal DNA data used for examination of species included the ITS1–5.8S–ITS2. Preliminary analyses were conducted on a large dataset (285 taxa; 340 sequences) with several different outgroups and exemplars of main clades suggested by analyses of Peintner et al. (2002a) and Garnica et al. (2005), and additional sequences of Australian sequestrate fungi (Francis 2007). Blast searches were conducted to

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check for any sequences that matched or were close matches to sequences of novel taxa. Close matches (97–100 %) were included in all alignments. In a series of successive analyses several sections known to be represented solely by Northern hemisphere taxa, i.e. *Calochroi*, or taxa showing no affinity to the new taxa described here (including numerous undescribed Australian sequestrate taxa), were removed. The final alignment included 178 sequences, representing 156 species, including a range of species within *Cortinarius* (98), *Descolea* (2), *Hebeloma* (3), and sequestrate taxa known to have affinities with these genera. *Agaricus bisporus* was selected as outgroup in final analyses, and a further 9 taxa from sister clades (*Agrocybe*, *Anamika*, *Gymnopilus*, *Inocybe*, *Laccaria*) also included to confirm placement of some *Hymenogaster* species. Twenty three novel sequences of Australian *Cortinariaceae* were included in the alignment and analyses (Table 1 lists all taxa with corresponding herbarium and GenBank accession numbers).

#### Nucleic acid preparation, amplification and sequencing

Genomic DNA was isolated with the QIAGEN DNeasy® Plant Mini Kit, following the manufacturer's protocol. The targeted regions were amplified from purified DNA using standard fungal primer pairs: ITS1/ITS4B and ITS5/ITS4 (Gardes & Bruns 1993, White et al. 1990).

Reactions were conducted in a volume of 50 µl and contained 1.25 U QIAGEN HotStar *Taq* DNA Polymerase, 10 pmol of each primer, 1.5 mM MgCl<sub>2</sub> and 0.25 mM each dNTP. Amplifications were performed in an Eppendorf Mastercycler Gradient Thermal Cycler. Cycling conditions consisted of a 15 m activation at 95 °C, followed by 30 cycles of 30 s at 94 °C, 30 s at 58 °C, and 1 m at 72 °C. These cycles were followed by 5 m of final extension at 72 °C, after which the product was held at 4 °C.

Products of amplification were purified using the Concert Rapid PCR Purification System (Life Technologies). Purified DNA was directly sequenced using the ABI Prism BigDye Terminator Cycle Sequencing Kit with primers for the ITS region ITS1, ITS5, and ITS4 (White et al. 1990). Sequencing was carried out by means of an ABI model Automated 377DNA Sequencer.

Assembly and manual editing of sequences for each region were performed using Sequencher 4.7 (GeneCodes). Sequences were then transferred to BioEdit v7.0.9 (Hall 2007) for alignment. Alignments were automated using ClustalX v2.0 (Thompson et al. 1997), and the alignment then manually edited. Previously unpublished sequence data is deposited in GenBank.

#### Phylogenetic analysis

Missing and ambiguous regions were removed from the analyses. All transformations were weighted equally. Gaps in the alignment were treated as missing data. All trees were rooted by the outgroup method (Maddison et al. 1984). Maximum parsimony analyses were performed using PAUP\* 4.0b10 (Swofford 2002). Heuristic searches of the dataset were conducted with 1 000 replicates of random addition sequence, tree bisection-connection (TBR) branch swapping and MULTREES on. Nodal support was tested by bootstrapping of 200 replicates with the heuristic search option (TBR and MULTREES off), including groups compatible with 50 % majority rule consensus, with 10 random addition sequences.

#### Morphology

The loss of gross morphological characters in the evolution of sequestrate sporocarp forms has led to a separate descriptive terminology to develop which we feel is confusing and, in the light of affinities shown by analysis of DNA sequences, unnecessary. In this paper we use the agaricoid descriptive terms wherever possible, however determining homology of some tissue types is difficult (i.e. veil and pellis structure). Macroscopic characters were described directly from fresh material. Colours are described in general terms only. Macrochemical tests were not recorded. Fresh material was dried in a food dehydrator at 35 °C for 12 h. Habitat, associated plant communities, and fruiting season are based on field notes.

Hand-cut sections of fresh and dried material were mounted in 5 % aqueous solution of KOH, then stained with Congo Red.

**Table 1** Taxa included in DNA analyses. Current nomenclature is given as well as names used in GenBank.

Current name	Genbank name	voucher	locale	Moser (1986) sections	Garnica et al. (2005) sections	Genbank #
<i>Agaricus bisporus</i>		HAI0235	UK			AJ884644
<i>Agaricus arvensis</i>		ARV1	USA			AY484691
<i>Agrocybe praecox</i>		PMB2310	USA			AY818348
<i>Anamika indica</i>		HK10098				AY948189
<i>Crepidotus mollis</i>		ubc f16579	Canada			FJ627025
<i>Gymnopilus eucalyptorum</i>		BRV 99/10	AU			AF501546
<i>Gymnopilus penetrans</i>		IB 19980105	AU			AF325663
<i>Inocybe geophylla</i>		OUC97144	Canada			DQ093854
<i>Inocybe rufofusca</i>		82	Austria			EU326156
<i>Descolea gunnii</i>		NZ2042	NZ			AF325653
<i>Descolea maculata</i>		E4986	AU			AF325651
<i>Descomyces albus</i>		H5339	AU			DQ328157
<i>Descomyces albus</i>		H5372	AU			DQ328168
<i>Descomyces angustisporus</i>		H7216	AU			DQ328058
<i>Descomyces</i> sp.		TL1608	AU			DQ328188
<i>Hebeloma ammophilum</i>		NP122	Austria			AY948190
<i>Hebeloma cavipes</i>		NP121	Austria			AY948193
<i>Hebeloma circinans</i>		dkad638	Netherlands			AF124699
<i>Laccaria ochropurpurea</i>		JMP0038	USA			EU819479
<i>Setchelliogaster australiensis</i>		Claridge 2621	AU			AF325628
<i>Setchelliogaster tenuipes</i>		Trappe 24776	AU			AF325624
<i>Timgrovea ferruginea</i>		H5803	AU			DQ328128
<i>Timgrovea</i> sp.		H4167	AU			DQ328109
<i>Timgrovea</i> sp.		H6171	AU			DQ328195
<i>Cortinarius alboaggregatus</i>		PDD 77472	NZ	<i>Phlegmacium</i>	<i>Pseudotriumphantes</i>	AY669620
<i>Cortinarius albiviolaceus</i>		IB 19740181		<i>Sericeocybe</i>	<i>Telamonia</i>	AF325596
<i>Cortinarius allutus</i>		IB 19940224		<i>Phlegmacium</i>	<i>Alluti</i>	AF325585

Table 1 (cont.)

Current name	Genbank name	voucher	locale	Moser (1986) sections	Garnica et al. (2005) sections	Genbank #
<i>Cortinarius anomalus</i>		IB 19950138		<i>Sericeocybe</i>	<i>Anomali</i>	AF325581
<i>Cortinarius archeri</i>		PERTH 05506395	AU	<i>Myxacium</i>		AY669610
<i>Cortinarius ardesiacus</i>		HO 970419A0	AU	<i>Telamonia</i>		AY669650
<i>Cortinarius argyrionus</i> sp. nov.		MEL2331641; MD158	AU			GQ890311
<i>Cortinarius argyrionus</i> sp. nov.		MEL2331642; MD163	AU			GQ890312
<i>Cortinarius argyrionus</i> sp. nov.		NE94635; MD162	AU			GQ890313
<i>Cortinarius australiensis</i>		ZT ACT72567	AU	<i>Phlegmacium</i>		AF389126
<i>Cortinarius australis</i>		HO A20420A0	AU	<i>Phlegmacium</i>		AY669615
<i>Cortinarius austrocinnabarinus</i>		MEL2089674	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890321
<i>Cortinarius austrocyranites</i>		PD 70498, CO1034	NZ	<i>Phlegmacium</i>		AY669626
<i>Cortinarius austroduracinus</i>		TUB 011522	Chile		<i>Renidentes</i>	AY669653
<i>Cortinarius austrosaginus</i>		HO 980509A0	AU	<i>Phlegmacium</i>		AY669619
<i>Cortinarius austrotumalis</i>		TUB 011469	Chile	<i>Phlegmacium</i>		AF539730
<i>Cortinarius austrovaginatus</i>		HO 990125A1	AU	<i>Phlegmacium</i>		AY669635
<i>Cortinarius austrovenetus</i>	<i>Dermocybe austroveneta</i>	MEL2089666	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890318
<i>Cortinarius balteatus</i>		TUB 011844	GER	<i>Phlegmacium</i>	<i>Phlegmacioides</i>	AY669526
<i>Cortinarius basipurpureus</i>	<i>Thaxterogaster basipurpureus</i>	PERTH 04259629	AU	<i>Myxacium</i>	<i>Myxacium</i>	AY669607
<i>Cortinarius basirubescens</i>	<i>Dermocybe</i> aff. <i>umbonata</i>	MEL2089698	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890328
<i>Cortinarius basirubescens</i>	<i>Dermocybe basirubescens</i>	MEL2089702	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890319
<i>Cortinarius basorapulus</i> sp. nov.		MEL2331650; KV621	AU			GQ890309
<i>Cortinarius caesibulga</i> sp. nov.		MEL2331651; KV660	AU			GQ890310
<i>Cortinarius caesibulga</i>		TL502A	AU			DQ328070
<i>Cortinarius caesibulga</i>	<i>Thaxterogaster</i> 'fragile'	Trappe 18313	AU		<i>Purpurascetes</i>	AF325559
<i>Cortinarius caesibulga</i>	<i>Thaxterogaster</i> sp.	H7127	AU			DQ328155
<i>Cortinarius caesibulga</i>	<i>Thaxterogaster</i> sp.	H0904	AU			DQ328146
<i>Cortinarius cagei</i>		TUB 011514	GER	<i>Telamonia</i>	<i>Telamonia</i>	AY669676
<i>Cortinarius campbellae</i>	<i>Thaxterogaster campbellae</i>	Trappe 19821	AU	<i>Phlegmacium</i>	<i>Purpurascetes</i>	AF325558
' <i>Cortinarius campbellae/levisporus</i> '	<i>Thaxterogaster campbellae</i>	MEL2032790	AU	<i>Phlegmacium</i>		DQ328102
<i>Cortinarius campbellae</i>	<i>Thaxterogaster campbellae</i>	HO727	AU	<i>Phlegmacium</i>	<i>Purpurascetes</i>	DQ328196
<i>Cortinarius campbellae</i>	<i>Thaxterogaster</i> sp.	TL503	AU			DQ328071
<i>Cortinarius camptoros</i>		TUB 011848	GER	<i>Phlegmacium</i>	<i>Caerulescentes</i>	AY669540
<i>Cortinarius canarius</i>		HO A20511C4	AU	<i>Dermocybe</i>		AY669630
<i>Cortinarius canarius</i>	<i>Dermocybe canaria</i>	MEL2089669	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890320
<i>Cortinarius caperatus</i>		TUB 011913	GER	<i>Rozites</i>	<i>Rozites</i>	AY669575
<i>Cortinarius chalybaeus</i>		PDD77482	NZ	<i>Phlegmacium</i>	<i>Purpurascetes</i>	AY669613
<i>Cortinarius cinereobrunneus</i>		IB 19630258		<i>Myxotelamonia</i>		AF325600
<i>Cortinarius cinereoseolus</i> sp. nov.		KV610	AU			GQ890314
<i>Cortinarius cinereoseolus</i> sp. nov.		MEL2331646; KV529	AU			GQ890315
<i>Cortinarius clelandii</i>	<i>Dermocybe clelandii</i>	MEL2089677	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890322
<i>Cortinarius coelopus</i>		HO 990504A3	AU	<i>Phlegmacium</i>	<i>Percomes</i>	AY669640
<i>Cortinarius collinitus</i>		IB 19960061		<i>Myxacium</i>	<i>Myxacium</i>	AF325573
<i>Cortinarius columbinus</i>		TUB 011473	Chile	<i>Phlegmacium</i>		AF539735
<i>Cortinarius cretax</i>		PDD 73148	NZ	<i>Phlegmacium</i>		AY669622
<i>Cortinarius croceus</i>	<i>Dermocybe crocea</i>	JFA9732	Austria	<i>Dermocybe</i>	<i>Dermocybe</i>	U56038
<i>Cortinarius cystidocatenatus</i>		HO A20518A6	AU	<i>Telamonia</i>	<i>Obtusi</i>	AY669651
<i>Cortinarius delaportei</i>		TUB 011853	GER		<i>Percomes</i>	AY669534
<i>Cortinarius delibutus</i>		IB 19860263		<i>Myxacium</i>	<i>Delibuti</i>	AF325580
<i>Cortinarius deminutus</i>	<i>Thaxterogaster redactus</i>	H0726	AU	<i>Myxacium</i>		DQ328172
<i>Cortinarius elaphinus</i>		TUB 011474	Chile	<i>Telamonia</i>		AF539725
<i>Cortinarius emodensis</i>		HKAS365-41	China		<i>Rozites</i>	AY669576
<i>Cortinarius erythraeus</i>		PERTH 05506727	AU	<i>Myxacium</i>		AY669605
<i>Cortinarius erythrocephalus</i>	<i>Dermocybe erythrocephala</i>	MEL2089681	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890323
<i>Cortinarius favrei</i>		IB 19990627		<i>Myxacium</i>	<i>Myxacium</i>	AF325575
<i>Cortinarius flavofucatus</i>		TUB 011476	Chile	<i>Icterinula</i>		AF539709
<i>Cortinarius globuliformis</i>		Claridge 2351	AU	<i>Dermocybe</i>	<i>Splendidi</i>	AF325582
<i>Cortinarius gracilior</i>		TUB 011857	GER	<i>Phlegmacium</i>	<i>Caerulescentes</i>	AY669525
<i>Cortinarius hercynicus</i>		TUB011824	GER	<i>Cortinarius</i>	<i>Cortinarius</i>	AY669580
<i>Cortinarius holojanthinus</i>	<i>Thaxterogaster violaceus</i>	Halling 5733	Argentina			AF325557
<i>Cortinarius humidicola</i>		IB 19970396	France	<i>Telamonia</i>		AF325594
<i>Cortinarius iringa</i>		PDD 73135	NZ	<i>Phlegmacium</i>		AY669624
<i>Cortinarius kapaturensis</i> sp. nov.		MEL2331649 KV603	AU			GQ890308
<i>Dermocybe kula</i>		HO 980515A0	AU	<i>Dermocybe</i>	<i>Splendidi</i>	AY669643
<i>Dermocybe kula</i>	<i>Dermocybe kula</i>	MEL2089692	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890325
<i>Cortinarius lacteus</i>		HO A20504A2	AU	<i>Phlegmacium</i>		AY669642
<i>Cortinarius langei</i>		TUB 011861	GER	<i>Phlegmacium</i>	<i>Percomes</i>	AY669527
<i>Cortinarius laniger</i>		IB 19740251		<i>Telamonia</i>	<i>Telamonia</i>	AF325591
<i>Cortinarius lavendulensis</i>		PERTH 05506735	AU	<i>Phlegmacium</i>	<i>Phlegmacioides</i>	AY669617
<i>Cortinarius lavendulensis</i>		HO 990304A2	AU	<i>Phlegmacium</i>	<i>Phlegmacioides</i>	AY669631
<i>Cortinarius levisporus</i>	<i>Thaxterogaster leucocephalus</i>	MEL2057558	AU			DQ328103
<i>Cortinarius levisporus</i>	<i>Thaxterogaster levisporus</i>	MEL2057536	AU			DQ328148
<i>Cortinarius lignyotus</i>		TUB 011478	Chile	<i>Telamonia</i>		AF539718
<i>Cortinarius lividochrascens</i>		IB 19960258		<i>Myxacium</i>	<i>Myxacium</i>	AF325565
<i>Cortinarius lividus</i>		TUB 011479	Chile	<i>Telamonia</i>		AF539734
<i>Cortinarius maculobulga</i> sp. nov.		MEL2331647 KV532	AU			GQ890306
<i>Cortinarius mairei</i>		IB 93/619	Austria	<i>Phlegmacium</i>	<i>Caerulescentes</i>	AY669548
<i>Cortinarius memoria-annae</i>		HO A20502A0	AU	<i>Phlegmacium</i>		EU660945

Table 1 (cont.)

Current name	Genbank name	voucher	locale	Moser (1986) sections	Garnica et al. (2005) sections	Genbank #
<i>Cortinarius minoscaurus</i>		PDD 71005	NZ	<i>Phlegmacium</i>		AY669628
<i>Cortinarius nanceiensis</i>		TUB 011422	GER		<i>Percomes</i>	AY174856
<i>Cortinarius nebulobrunneus</i> sp. nov.		MEL2331648 KV588	AU			GQ890307
<i>Cortinarius nebulobrunneus</i>	<i>Thaxterogaster</i> sp.	Trappe 18741	AU			AF325587
<i>Cortinarius ochraceoazureus</i>		ZT RA6743	Argentina	<i>Telamonia</i>		AY033122
<i>Cortinarius olivaceopictus</i>	<i>Dermocybe olivaceopicta</i>	JFA11110	USA	<i>Dermocybe</i>	<i>Dermocybe</i>	DOU56050
<i>Cortinarius olivaceopictus</i>	<i>Dermocybe</i> aff. <i>olivaceopicta</i>	MEL2120743	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890316
<i>Cortinarius pachynemeus</i>		AH 13475	Chile	<i>Telamonia</i>	<i>Obtusi</i>	AF539727
<i>Cortinarius papulosus</i>		TUB 011867	GER	<i>Phlegmacium</i>	<i>Percomes</i>	AY669555
<i>Cortinarius parahumilis</i>		TUB 011293			<i>Renidentes</i>	AF539731
<i>Cortinarius pavelekii</i>	<i>Thaxterogaster pavelekii</i>	Trappe 7962	USA	<i>Myxacium</i>		AF325564
<i>Cortinarius percomis</i>		TUB 011868	GER		<i>Percomes</i>	AY669529
<i>Cortinarius permagnificus</i>		AH 19524	Chile	<i>Phlegmacium</i>		AF539722
<i>Cortinarius persplendidus</i>	<i>Dermocybe splendida</i>	Horak NZ920	NZ	<i>Dermocybe</i>	<i>Dermocybe</i>	AF325583
<i>Cortinarius persplendidus</i>	<i>Dermocybe splendida</i>	MEL2089694	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890327
<i>Cortinarius pinguis</i>	<i>Thaxterogaster pinguis</i>	IB 19951102		<i>Myxacium</i>		AF325571
<i>Cortinarius piriforme</i>	<i>Thaxterogaster piriformis</i>	Trappe 20116	AU	<i>Myxacium</i>		AF325569
<i>Cortinarius 'porphyroideus'</i>	<i>Thaxterogaster piriformis</i>	MEL2079347	NZ	<i>Myxacium</i>		DQ328106
<i>Cortinarius porphyroideus</i>	<i>Thaxterogaster porphyreus</i>	NZ8468	NZ	<i>Myxacium</i>		AF325577
<i>Cortinarius porphyropus</i>		IB 19990515		<i>Phlegmacium</i>	<i>Purpurascens</i>	AF325560
<i>Cortinarius pseudotriumphans</i>		TUB 011873	Chile	<i>Phlegmacium</i>	<i>Pseudotriumphantus</i>	AY669600
<i>Cortinarius purpurascens</i>		TUB 011401	GER	<i>Phlegmacium</i>	<i>Purpurascens</i>	AY174858
<i>Cortinarius purpurascens</i> var. <i>largusoides</i>		TUB011871	GER	<i>Phlegmacium</i>	<i>Purpurascens</i>	AY669538
<i>Cortinarius quaresimalis</i>		HO A20606A5	AU	<i>Myxacium</i>		AY669616
<i>Cortinarius rapaceus</i> var. <i>luridus</i>		TUB 011485	Chile	<i>Phlegmacium</i>	<i>Pseudotriumphantus</i>	AF539724
<i>Cortinarius renidens</i>		TUB 011516	GER		<i>Renidentes</i>	AY669652
<i>Cortinarius rotundisporus</i>		NZ8501	NZ	<i>Myxacium</i>		AF389127
<i>Cortinarius salmaster</i>		HO A20528A3	AU	<i>Phlegmacium</i>		AY669618
<i>Cortinarius salor</i>		IB 19940297		<i>Myxacium</i>	<i>Delibuti</i>	AF325579
<i>Cortinarius sarcinochrous</i>	<i>Thaxterogaster albocanus</i>	Halling 5832	Argentina	<i>Myxotelamonia</i>		AF325599
<i>Cortinarius scaurus</i>		IB 19940243		<i>Phlegmacium</i>	<i>Scauri</i>	AF325563
<i>Cortinarius sclerophyllarum</i>		HO A20430A6	AU	<i>Phlegmacium</i>	<i>Anomali</i>	AY669637
<i>Cortinarius sebosus</i>		H7265	AU			DQ328060
<i>Cortinarius sejunctus</i>		HO 990125A0	AU	<i>Phlegmacium</i>	<i>Splendidi</i>	AY669636
<i>Cortinarius similis</i>		HKAS 26154	China	<i>Rozites</i>	<i>Rozites</i>	AY669577
<i>Cortinarius sinapicolor</i>		PERTH 05506778	AU	<i>Myxacium</i>		AY669604
<i>Cortinarius sinapivelus</i> sp. nov.		MEL2331645 KV518	AU			GQ890305
<i>Cortinarius spadicellus</i>		O-65723	Norway	<i>Phlegmacium</i>	<i>Phlegmacioides</i>	AY669539
<i>Cortinarius subcastanellus</i>		NZ800	NZ	<i>Rozites</i>		AY033112
<i>Cortinarius subcastanellus</i>		PDD 77482	NZ	<i>Rozites</i>		AY669623
<i>Cortinarius submagellanicus</i>		HO A20518A1	AU	<i>Myxacium</i>	<i>Purpurascens</i>	AY669614
<i>Cortinarius submeleagris</i>		HO 990411A1	AU	<i>Rozites</i>	<i>Rozites</i>	AY669638
<i>Cortinarius talus</i>		IB 19990590		<i>Phlegmacium</i>	<i>Alluti</i>	AF325586
<i>Cortinarius tenellus</i>		TUB 011489	Chile	<i>Telamonia</i>	<i>Obtusi</i>	AF539728
<i>Cortinarius walkeri</i>		HO A20528A0	AU	<i>Dermocybe</i>		AY669632
<i>Cortinarius vinaceolamellatus</i>		PERTH 05506786	AU	<i>Phlegmacium</i>	<i>Rozites</i>	AY669608
<i>Cortinarius violaceus</i>		PERTH 05506794	AU	<i>Cortinarius</i>		AY669578
<i>Cortinarius viridibasilis</i>		TUB 011490	Chile	<i>Telamonia</i>	<i>Renidentes</i>	AF539717
<i>Cortinarius</i> sp.	<i>Dermocybe austrosanguinea</i>	MEL2089685	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890317
<i>Cortinarius</i> sp.	<i>Dermocybe chloroapica</i>	MEL2120747	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890324
<i>Cortinarius</i> sp.	<i>Dermocybe magentiannulata</i>	MEL2089705	AU	<i>Dermocybe</i>	<i>Dermocybe</i>	GQ890326
<i>Cortinarius</i> sp.		PDD 77486	NZ	<i>Phlegmacium</i>	<i>Percomes</i>	AY669644
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H5362	AU			DQ328077
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H6585	AU			DQ328080
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H0920	AU			DQ328090
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	MEL2059057	AU			DQ328107
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H1194	AU			DQ328117
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H1120	AU			DQ328122
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H1013	AU			DQ328145
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H6558	AU			DQ328149
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H4770	AU			DQ328151
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H0910	AU			DQ328179
<i>Cortinarius</i> sp.	<i>Thaxterogaster</i> sp.	H1446	AU			DQ328216
<i>Hymenogaster arenarius</i>		H0790	AU			DQ328124
<i>Hymenogaster australis</i>		H0791	AU			DQ328132
<i>Hymenogaster brunnescens</i>		AHS 68806				EU084967
<i>Hymenogaster bulliardii</i>		OSC Trappe12842	Spain			AF325641
<i>Hymenogaster citrinus</i>		K(M)136970	?Europe			EU784360
<i>Hymenogaster subalpinus</i>		Trappe 22752	USA			AF325640
<i>Hymenogaster subolivaceus</i>		AHS 34677				EU084961
<i>Protoglossum aromaticum</i>		VIDAL 980620-6				EU084962
<i>Protoglossum violaceum</i>		H6358	AU	<i>Myxacium</i>		DQ328081
<i>Protoglossum viscidum</i>		Rodway 1272a	AU			EU084982
<i>Quadrispora oblongispora</i>		Trappe 18111	AU	<i>Myxacium</i>		AF325566
<i>Quadrispora tubercularis</i>		PERTH00960403	AU	<i>Myxacium</i>		DQ328113

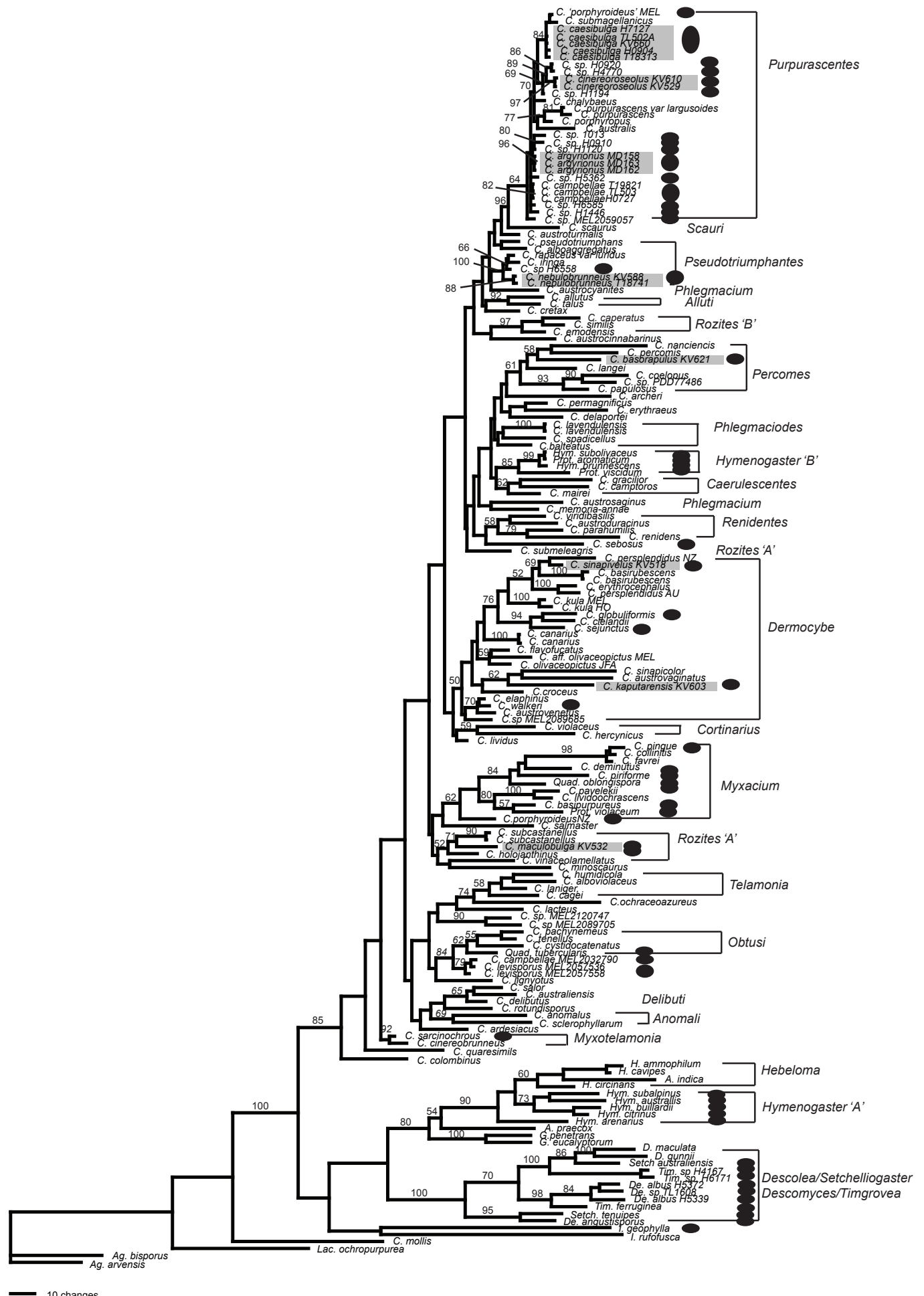


Fig. 1 Heuristic analysis of ITS sequence data; one of 4 298 trees of length 3 716. Bootstrap support shown above lines. 'oval' = sequestrate taxa.

To determine the amyloid reaction, dried material was stained with Melzer's reagent. Measurements were made at  $\times 400$  or  $\times 1\ 000$  with a calibrated ocular micrometer. Spore dimensions are given as length range  $\times$  width range, mean length  $\times$  width ( $n = 10$  unless specified). The length : width ratio ( $Q$ ) is presented as the range of  $Q$  values and the mean  $Q$ . Measurements do not include the apiculus or ornamentation. Basidia and cystidia dimensions are given as length range  $\times$  width range ( $n = 10$ ). Material for scanning electron microscopy (SEM) was sputter-coated with gold and photomicrographs taken using a JEOL JSM-5600 machine. Scanning electron microscope photographs were referred to wherever possible to aid interpretation of spore ornamentation patterns, however descriptions are in terms of structures visible by light microscopy and are based on type material (except where noted).

Names of herbaria are abbreviated according to Holmgren et al. (1990).

## RESULTS

The alignment of ITS sequences consisted of 774 characters, of which 672 were included in analyses (222 were constant and 450 were parsimony informative). Analyses produced 4 298 trees of 3 716 steps,  $CI = 0.873$ ,  $RI = 0.881$  (Fig. 1.)

A number of clades representative of sections sensu Peintner et al. (2002a) and Garnica et al. (2005) were recovered, though bootstrap support was not strong in the deeper branches (Table 1; Fig. 2). However, there is strong support (100 % bootstrap) for a distinct *Cortinarius* clade separate from a *Descolea/Hebeloma* clade. The *Hymenogaster* A clade, appears to have strong affinities to *Descolea/Hebeloma* rather than within *Cortinarius* with *Hymenogaster* B, including *Protoglossum viscidum* and *P. aromaticum* (Fig. 2). Although preliminary results only, some microscopic features such as spore size (generally considerably larger in *Hymenogaster* A), and ornamentation (more robust in *Hymenogaster* A), provide some support for distinguishing the two *Hymenogaster* clades.

The eight newly described taxa are scattered in different lineages within *Cortinarius*: *C. argyronius*, *C. caesibulga* and *C. cinereoroseolus* are in section *Purpurascetes*, *C. maculobulga* in section *Rozites*, *C. sinapivelus* in section *Splendidi*, *C. kaputarensis* in a mixed section *Phlegmacium/Myxadium* within a broader section *Dermocybe*, *C. basorapulus* in section *Percomes* and *C. nebulobrunneus* in section *Pseudotriumphantes*. Macroscopic and microscopic characters of the new species provide further support for placement in these various sections (discussed further in notes under each taxon). Historically these taxa would have been ascribed, based on morphology, to the genera *Thaxterogaster*, *Hymenogaster* or *Protoglossum*. However, *Thaxterogaster* has been synonymised with *Cortinarius*, and species of *Hymenogaster* and *Protoglossum* are scattered in several different clades thus the genera can no longer be considered monophyletic nor distinct from *Cortinarius* or *Descolea/Hebeloma*. Nomenclatural changes in the genus *Protoglossum* will be dealt with in a separate paper (May & Lebel in prep).

Very few clades contain solely sequestrate taxa. This may be partially a consequence of taxon sampling, as relatively few sequences have been available until recently, and also to the great diversity of sequestrate fungi currently undescribed from Australasia. Several sequestrate taxa will require further investigation of type material, for example *C. porphyroideus*, as sequences appear in radically different clades (*Purpurascetes* and *Myxadium*).

## Taxonomy

### Key to genera of the Bolbitiaceae and Cortinariaceae containing sequestrate taxa

1. Spores with a smooth, rostrate apex, and distinct utricle . . . . . 2
1. Spores with a rounded ornamented apex, and lacking a distinct utricle . . . sequestrate *Cortinarius* (and *Protoglossum*)
2. Basidiomes with distinct stipe; spores prominently asymmetrical . . . . . *Setchelliogaster*
2. Basidiomes lacking stipe-columella; spores more or less symmetrical . . . . . *Descomyces/Timgrovea*

### Key to Australian sequestrate species of Cortinarius and Protoglossum

1. Stipe-columella lacking, much reduced or as a truncate basal pad . . . . . 2
1. Stipe-columella distinct, prominent . . . . . 21
2. Basidiomes white, yellow, orange or brown . . . . . 9
2. Basidiomes with lilac/violet tints . . . . . 3
3. Gleba sublamellate . . . . . **3. *C. caesibulga***
3. Gleba loculate or labyrinthoid . . . . . 4
4. Peridium gelatinous, viscid or with a thick layer of slime 5
4. Peridium not as above . . . . . 7
5. Basidiomes initially pale tan becoming reddish/purple brown or grey/violet; stipe-columella white to cream, dry, with a gelatinous purple collar at junction of peridium and stipe . . . . . *C. basipurpureus*
5. Basidiomes lacking the reddish/brown tones; stipe-columella absent or truncate, white to violet, dry or viscid, lacking a gelatinised purple collar . . . . . 6
6. Spores ellipsoid,  $12.5\text{--}14.5(-16) \times 6\text{--}8\ \mu\text{m}$ ; peridium silvery white with violet tints to violet/lilac overall . . . . . *P. niphophilum*
6. Spores obovoid to broadly ellipsoid,  $8.5\text{--}10.5(-12) \times 6\text{--}7(-10)\ \mu\text{m}$ ; peridium violet fading to greyish violet, or greyish brown/orange . . . . . *P. violaceum*
7. Basidiomes not caespitose, cream to pink-lilac-grey, slightly shiny; spores ornamented with robust irregular nodules pegs and some short broad lines to  $1.5\ \mu\text{m}$  tall . . . . . **4. *C. cinereoroseolus***
7. Basidiomes often caespitose, lacking pink tones, may be shiny or not; spore ornamentation lower and less robust or lacking any connecting lines between elements . . . . 8
8. Spores ornamented with irregular crowded nodules to  $1.5\ \mu\text{m}$  tall. Basidiomes silvery grey to violet with metallic sheen; stipe-columella white staining violet at margins . . . . . **1. *C. argyronius***
8. Spores ornamented with low nodules  $< 0.8\ \mu\text{m}$  tall, connected by scattered short lines. Basidiomes brownish violet, lacking metallic sheen; stipe-columella remaining white . . . . . *C. campbellae*
9. Peridium overall viscid or covered with a layer of slime 10
9. Peridium dry or appearing moist . . . . . 18
10. Spores retained in tetrads after release . . . . . 11
10. Spores not retained in tetrads after release . . . . . 13
11. Basidiomes pale violet fading to brown with age . . . . . *Quadrispora musispora*
11. Basidiomes brown, warm brown to apricot yellow, drying brown or greyish yellow . . . . . 12
12. Basidiomes brown; spores subovoid, coarsely ornamented with irregular tubercles and ridges to  $2\ \mu\text{m}$  high . . . . . *Quadrispora tubercularis*



**Fig. 2** Sporocarps of new species. a. *Cortinarius argyrioides*; b. *C. basorapulus*; c. *C. caesibulga*; d. *C. cinereoroseolus*; e. *C. kaputarensis*; f. *C. maculobulga*; g. *C. nebulobrunneus*; h. *C. sinapivelus*. — Scale bars = 10 mm.

12. Basidiomes warm brown to apricot yellow; spores ellipsoidal to oblong, ornamented with crowded, irregular tubercles and ridges to 1 µm high . . . . . *Quadrispora oblongispora*
13. Spores 15–18 × 8.5–12 µm, ornamented with crowded fine verrucae; basidiomes dark brown overall . . . . . *C. deminutus* Peintner
13. Spores almost all < 15 µm in length, ornamented with crowded fine verrucae or short ridges; basidiomes may have brown tints but not dark brown overall . . . . . 14
14. Basidiomes creamy tan with brown patches . . . . . **6. *C. maculobulga***
14. Basidiomes brown with yellow, orange or copper tints 15
15. Basidiomes yellow-orange with orange-red stains; stipe pale yellow with gelatinous red collar at junction of peridium and stipe; spores densely ornamented with irregular rods and short ridges to 1 µm tall . . . . . *C. luteirufescens*
15. Basidiomes coloured differently and lacking orange-red stains; stipe lacking gelatinous red collar; spores mostly finely verrucose and less than 1 µm tall . . . . . 16
16. Basidiomes brownish orange to brown; stipe-columella variable; spores mostly ≤ 8 µm wide . . . . . *C. piriforme*
16. Basidiomes yellow/orange/copper red to dark brown; small basal pad present or lacking; spores mostly > 8 µm wide . . . . . 17
17. Spores 11–13 × 8.5–11 µm; ornamentation to 1.5 µm tall, of irregular rods and short ridges, perisporium conspicuous, closely adhering . . . . . *P. luteum*
17. Spores 11–15.5 × 7.5–9 µm, more ellipsoid; ornamentation to 0.8 µm tall, finely verrucose, perisporium conspicuous, appearing reticulately wrinkled . . . . . *P. viscidum*
18. Spores ≤ 10 × 6 µm . . . . . 19
18. Spores > 10 × 6 µm . . . . . 20
19. Basidiomes whitish, sometimes with cinnamon fibrils; spores golden brown, ellipsoid, ornamented with small warts or rods, 7–10 × 3–5.5 µm . . . . . *C. walpolensis*
19. Basidiomes white to yellow ochre; spores yellow brown to red brown, ovoid to ellipsoid, finely verrucose, 6–9.5 × 4–5.5 µm . . . . . *C. levisporus*
20. Spores 12.6–14 × 6.3–7.8 µm, cinnamon brown, ovoid, finely nodulose; basidiomes whitish with brown patches; stipe-columella truncate to percurrent **6. *C. maculobulga***
20. Spores 14.5–18.5 × 9–13 µm, dark chestnut brown, amygdal-citriniform, verrucose; basidiomes olive brown; stipe-columella truncate or lacking . . . . . *C. scabrosus*
21. Basidiomes with distinct yellow persistent partial veil . 22
21. Basidiomes not as above . . . . . 25
22. Basidiomes ‘flattened parachute-shaped’, bright yellow; stipe-columella short, somewhat bulbous; spores ellipsoid to subglobose, ornamented with rods and short ridges to 1 µm tall . . . . . *C. globuliformis*
22. Basidiomes agaricoid, brown with some yellow tints; stipe-columella long; spores shaped differently, ornamentation nodulose to roughly verrucose . . . . . 23
23. Spores ellipsoid to ovoid, 11.4–15.2 × 6.8–8.7 µm . . . . . *C. flavovellus*
23. Spore ovoid to almond-shaped or broadly ovoid, all less than 12 µm long . . . . . 24
24. Pileus convex, pale brown with yellow fibrils; spores broadly ovoid, 8.9–10.0 × 6.5–7.5 µm . . . . . **8. *C. sinapivelus***
24. Pileus conical to subglobose often with flattened apex, yellow-brown to orange-brown with brown fibrils, subviscid; spores ovoid to almond-shaped, 9.9–12.0 × 5.5–7.5 µm . . . . . **5. *C. kaputarensis***
25. Basidiomes pigmented with distinct dark brown, purple, orange or green tints; stipe generally lacking marginate base . . . . . 29
25. Basidiomes white, cream, grey or pale tan brown; stipe with distinctly marginate bulbous or angular base or barely slightly bulbous (not marginate) . . . . . 26
26. Spores 14–21 µm long; basidiomes of variable colour cream, greenish grey . . . . . *C. sebosus*
26. Spores all < 15 µm long; basidiomes off-white, greyish to pale tan brown . . . . . 27
27. Basidiomes off-white to greyish, viscid; spores 12.5–14.5 × 8–11 µm . . . . . *C. leucocephalus*
27. Basidiomes pale tan, sometimes with whitish bloom overlying, not viscid; spores 9.0–11.6 × 5.5–9.5 µm . . . . . 28
28. Stipe with marginate bulbous base; spores broadly ellipsoid, 9.6–11.6 × 7–9.4 µm . . . . . **2. *C. basorapulus***
28. Stipe attenuating towards base; spores ellipsoid, 9–11 × 5.5–6.5 µm . . . . . *C. cunninghamii*
29. Basidiomes with purple tints . . . . . 30
29. Basidiomes lacking purple tints, brown or orange present . . . . . 31
30. Spores 7.7–9(–11) × 5–6.5 µm; basidiomes with a silvery sheen . . . . . **1. *C. argyrionus***
30. Spores 14–21 × 9–18 µm; basidiomes dull . . . . . *C. sebosus*
31. Basidiomes parachute-shaped; stipe-columella short, base marginate; with thick white partial veil . . . . . *C. debbiae*
31. Basidiomes shaped differently; stipe-columella either longer or not marginate; lacking thick white partial veil . . . . . 32
32. Stipe-columella white slightly translucent, robust, extending > 30 mm beyond pileus; spores 9–11.9 × 5.5–6.5 µm . . . . . **7. *C. nebulobrunneus***
32. Stipe-columella brown, slender, extending < 12 mm beyond pileus; spores 8.5–10.5 × 4.7–6 µm . . . . . *C. orphinus*

## DESCRIPTIONS

**1. *Cortinarius argyrionus*** Danks, T. Lebel & Vernes, *sp. nov.*  
— MycoBank MB515235; Fig 2a, 3, 4

Sporocarpia hypogaea vel emergentia, caespitosa, 6–20 mm lata, subglobose vel turbinata, grosse rugosa; pileus argenticinereus vel pallidoviolaceus, non viscidus. Velum violaceum, crassum, persistens. Hymenophorum loculatum initio sordido brunneum vel cinnamomeum, maturitate fuscobrunneum; trama violascens suffusa retinens. Stipes 9–30 × 2–7 mm, percurrens, solidus, albus vel argenti-violaceus, contextus albus dein centrum luteolum et margine violaceo. Pileipellis bistrata, extus hyphis tenuibus hyalinis gelatinosis; interne hyphis latis luteobrunneis non-gelatinosis. Basidiosporae asymmetricae, late ovatae, 7.7–9(–11) × (4.5–)5–6.5 µm, in KOH pallide luteobrunnae, nodulosis irregularibus inconspicuis vel robustis, < 1.5 µm altis. — Typus: *M. Danks K. Vernes T. Cooper & S. Steinhart MD163* (MEL2331642) (holotypus hic designatus), Australia, New South Wales, Armidale, Newholme Field Station, Plot PA4, 1 July 2008.

*Etymology.* Name refers to the metallic sheen and silvery-violet colour of the sporocarps (Gk.: argyrionus = silvery violet).

*Sporocarps* hypogeous to emergent under leaf litter, fruiting in large clusters, often caespitose (multi-bodied). *Pileus* 7–38 × 6–20 mm diam, irregularly subglobose to pyriform or turbinata, coarsely wrinkled with plicate margin, attached to stipe by a persistent, cottony violet partial veil becoming paler with age. *Pellis* pale violet to silvery-grey with a metallic sheen, radiate-fibrillose, dry to moist when fresh but not viscid, sometimes with adhering debris, not hygrophanous, not bruising, with overlying remnant silvery-grey, fibrillose-silky veil, easily rubbed off with handling. *Context* 0.5–1.5 mm thick, white to cream, generally thicker at apex. *Hymenophore* dull brown to cinnamon brown initially becoming rich dark brown, trama initially pale violet, becoming white to grey retaining some violet tints in older speci-



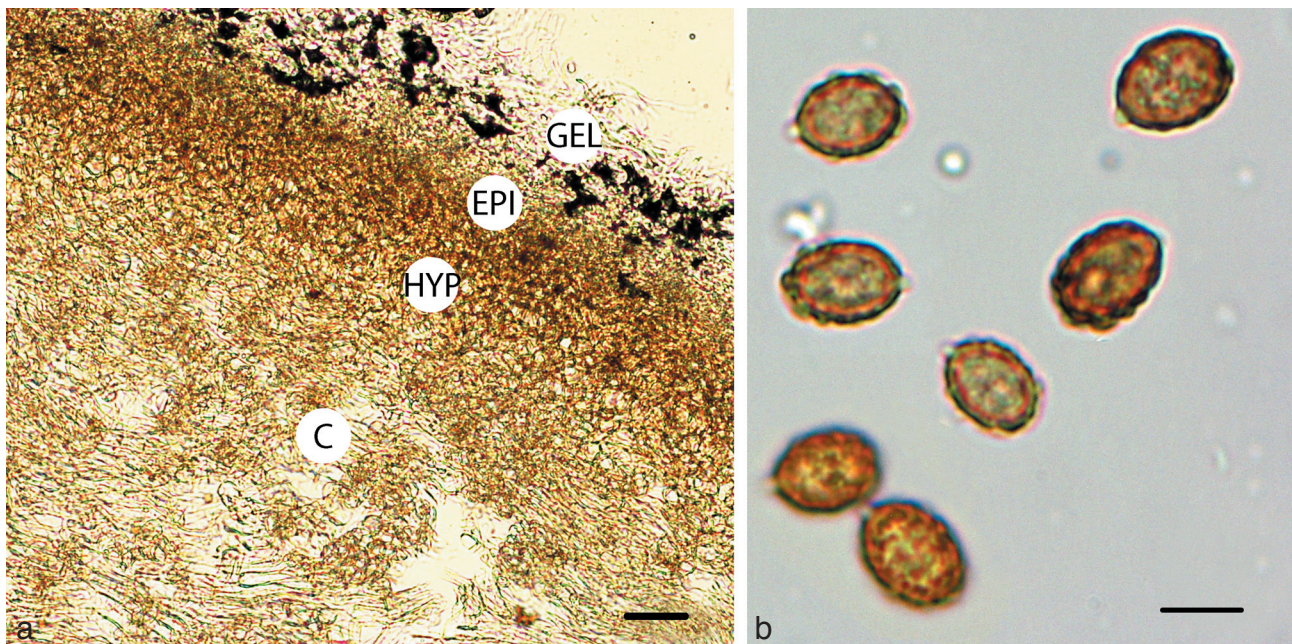


Fig. 3 *Cortinarius argyrius*. a. Pileipellis; b. spores (GEL = outer layer; EPI = epicutis; HYP = hypocutis; C = context). — Scale bars: a = 50  $\mu$ m; b = 5  $\mu$ m.

mens; loculate, chambers empty, regular, rounded to elongate and radially arranged. *Stipe-columella* generally percurrent in immature sporocarps and occasionally percurrent, more often truncate, in mature sporocarps, 9–30  $\times$  2–7 mm diam, white to silvery violet, context white gradually becoming pale yellow tinted in centre and violet at margins, solid, central, slender, convoluted and equal or slightly bulbous to base or tapering to somewhat inserted base; *partial veil* inconspicuous but present between inrolled margin and stipe-columella, cortinoid to cottony, concolorous silvery-grey to violet (more obvious in younger specimens). *Basal mycelium* inconspicuous. *Odour* strong earthy fungoid, not unpleasant; *taste* not distinctive.

*Spores* 7.7–9(–11)  $\times$  (4.5–)5–6.5  $\mu$ m, mean (30 spores) = 8.8  $\times$  5.6  $\mu$ m, Q = 1.2–2.0, mean Q = 1.62, cinnamon brown (KOH), broadly ovoid, slightly asymmetrical, ornamented with irregular crowded nodules, nodules inconspicuous or robust to 1.5  $\mu$ m tall, usually angular, often taller and more robust towards apex; hilar appendage to 1  $\mu$ m, hyaline, conspicuous, tapering, truncate, entire; spores inamyloid non-dextrinoid. *Basidia* 20–40  $\times$  5–7  $\mu$ m, hyaline, clavate to cylindrical, thin-walled, with 4 sterigmata. *Cystidia* 12–32  $\times$  3–9  $\mu$ m, hyaline, clavate,

thin-walled, scattered and never protruding beyond hymenium. *Hymenophoral trama* 65–140  $\mu$ m wide, of interwoven, hyaline, gelatinised, thin-walled, narrow hyphae, 3–6  $\times$  20–50  $\mu$ m; subhymenium 20–35  $\mu$ m undifferentiated from trama. *Pileipellis duplex*. Outer gelatinised layer 35–50  $\mu$ m wide, of loosely interwoven, hyaline, partially gelatinised, thin-walled, narrow hyphae, 4–6  $\mu$ m diam; *epicutis* 30–65  $\mu$ m wide, of more densely compacted, hyaline to pale yellowish in KOH, narrow filamentous hyphae, 3–6  $\mu$ m diam; *hypocutis* 65–110  $\mu$ m wide, of densely packed, yellow-brown tinted, non-gelatinised, thick-walled (to 1  $\mu$ m), ovoid, ellipsoid to subglobose or rectangular inflated hyphae 8–18  $\mu$ m diam  $\times$  8–22  $\mu$ m long; *context* 250–300  $\mu$ m wide, of parallel to somewhat interwoven, hyaline, non-gelatinised, hyphae 8–12  $\mu$ m diam. *Partial veil* of subparallel to somewhat interwoven, thin-walled, hyaline hyphae 2–5  $\mu$ m broad. *Clamp connections* present in the pileus and hymenial tissues.

*Habitat & Distribution* — In New South Wales, found in low hills and plains near Mt Duval on the New England Tableland, among paddock shelterbelt plantings of *Acacia filicifolia*, *Eucalyptus nova-anglica*, *E. stellulata*, *E. viminalis*, *Hakea micro-*

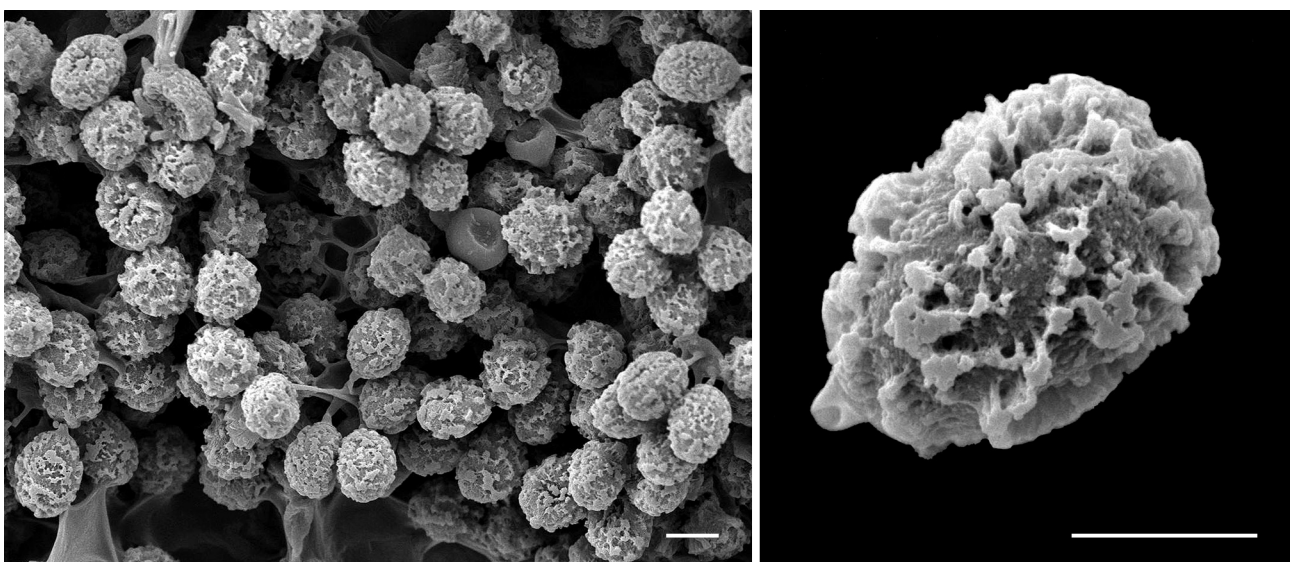


Fig. 4 Scanning electron micrographs of *Cortinarius argyrius* spores. — Scale bars = 10  $\mu$ m.

*carpa*, *H. salicifolia* and *Leptospermum flavescens*. Fruiting: June and July.

**Specimens examined.** AUSTRALIA, New South Wales, Armidale, Newholme Field Station, Plot PA4, 1 July 2008, M. Danks K. Vernes T. Cooper & S. Steinhart MD158 (MEL2331641); Armidale, Newholme Field Station, Plot PA4, 1 July 2008, M. Danks K. Vernes T. Cooper & S. Steinhart MD 162 (NE94635); Armidale, Newholme Field Station, Plot PA6, 2 June 2009, M. Danks & S. Steinhart MD213 (MEL2331643 & NE94636); Armidale, Newholme Field Station, Plot PA4, 2 June 2009, S. Steinhart MD222 (MEL2331644).

**Notes** — Numerous violet-lilac tinted species of *Cortinarius* occur in Australia, including several that lack a thick gelatinous pileipellis. *Cortinarius argyrionus* differs macroscopically in the often caespitose sporocarps, with loculate hymenophore, and the initially white stipe context which gradually becomes pale yellow tinted in the centre and violet at the margins. Microscopically, the robust nodulose spore ornamentation (to 1.5 µm), and structure of the pileus are distinct from other violet-lilac tinted sequestrate *Cortinarius* species.

Based on analyses of ITS sequence data, *Cortinarius argyrionus* belongs in a well-supported (bootstrap 64 %) section *Purpurascentes*, with two other new species *C. caesibulga* and *C. cineoroseolus* (Fig. 1). Section *Purpurascentes* also includes a strongly supported subclade with northern hemisphere species *C. porphyropus*, *C. purpurascens* and *C. purpurascens* var. *largusoides* (bootstrap 77 %), the southern hemisphere species *C. australis*, *C. chalybaeus*, *C. submagellanicus* and *C. campbellae*, and several undescribed Australian sequestrate taxa. Section *Scauri* is a strongly supported sister clade (bootstrap 96 %). All taxa within section *Purpurascentes* have lilac/purple-tinted sporocarps with varying degrees of gelatinisation of pellis hyphae, minute to robust spore ornamentation, and a pileipellis duplex.

*Cortinarius argyrionus* is strongly supported (bootstrap 96 %) in a subclade as distinct from two undescribed sequestrate taxa *C. sp. H1120* and *C. sp. H0910 & H1013* (bootstrap 80 %). Both of these undescribed taxa have a pileus that is pale matt brownish purple rather than pale violet to silvery-grey with metallic sheen, and a stipe that lacks the violet margin staining reaction of *C. argyrionus*. The structure of the pileus, and spore size and ornamentation also differ from *C. argyrionus*.

The Australian sequestrate fungus, *Cortinarius campbellae* (bootstrap 82 %), may have some purple tints to the sporocarp, however it is much darker 'brownish violet or maderia' than either *C. argyrionus* or *C. caesibulga*, has slightly smaller spores with less robust ornamentation, and hypocutis hyphae that are broader (Beaton et al. 1984). A third sequence labelled '*C. campbellae*' (MEL2032790) appears distant in a well-supported subclade (bootstrap 79 %) with *C. levisporus*, and sister to a section *Obtusi* subclade (62 %). On examination, this collection matches reasonably with *C. levisporus* with a very pale tan pileus with concolorous veil rather than brownish violet or maderia, the hymenophore is loculate rather than lamellate, the stipe reduced, the pileipellis hyphae predominantly ellipsoid, and the spores slightly narrower (Beaton et al. 1984). Further investigation, including examination of type material is required in order to determine the appropriate name for other sequestrate taxa in the section *Purpurascentes* clade.

**2. *Cortinarius basorapulus*** Danks, T. Lebel & Vernes, *sp. nov.* — MycoBank MB515236; Fig. 2b, 5, 6

Sporocarpia hypogaea vel emergentia, 11–29 mm lata, convexa vel subglobulosa; pileus eburneus vel pallidobrunneolus, non viscidus. Velum album crassum, persistens. Hymenophorum sublamellatum contortum et plicatum vel loculatum labyrinthiforme, juventute pallidobrunneolum, maturitate leviter fuscum. Stipes 14–36 × 5–8 mm, percurrens, solidus, robustus, basi bulbosus marginatus angustus ad apicem, albus vel eburneus, non-viscidus; contextus albus maculatus, basi brunneus. Pileipellis monostrata, hyphis tenuibus luteis non-gelatinosis. Basidiosporae asymmetricae, late ellipsoideae, 9.6–11.6(–12.1) × 7–9.4 µm, in KOH auranteobrunneum, verrucis irregularibus tenuibus 0.3–0.5 µm altis. — Typus: M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV621 (holo MEL2331650 (holotypus hic designatus); iso NE94642), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot DS3, 18 July 2007.

**Etymology.** Name refers to the turnip-like shape of the bulbous base of the sporocarps (L.: rapulum = a little turnip; baso = base).

**Sporocarps** hypogeous to emergent under leaf litter, in a small group. **Pileus** 8–24 × 11–29 mm diam, convex to subglobose, occasionally with a flattened apex, and slightly plicate margin attached to stipe by a persistent white, cottony partial veil. **Pellis** off-white to pale tan brown, finely fibrillose to fealty, dry, not hygrophanous, not bruising, with overlying remnant pale

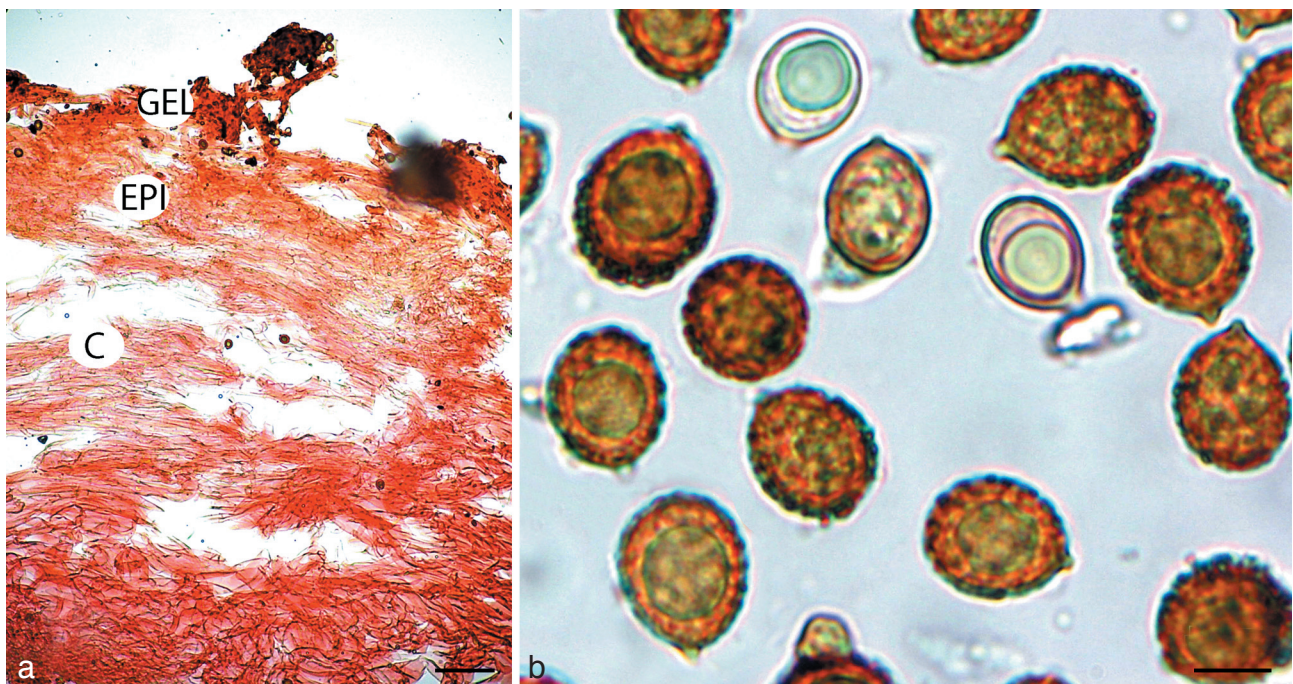


Fig. 5 *Cortinarius basorapulus*. a. Pileipellis; b. spores. — Scale bars: a = 50 µm; b = 5 µm.

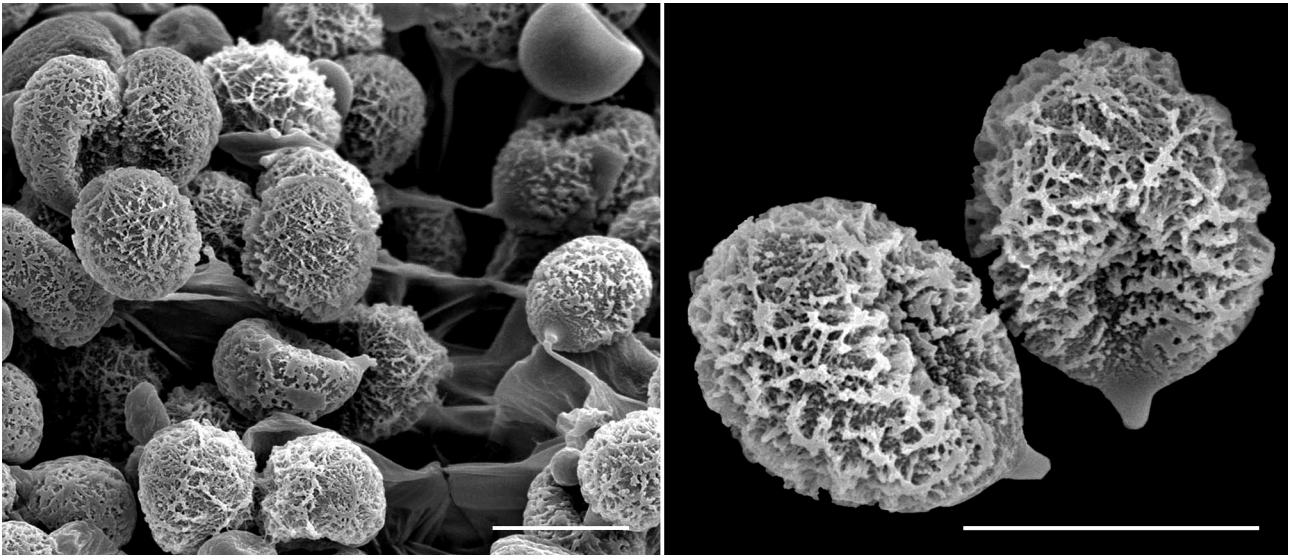


Fig. 6 Scanning electron micrographs of *Cortinarius basorapulus* spores. — Scale bars = 10  $\mu\text{m}$ .

tan fibrillose veil, giving a white to tan 'bloom', easily rubbed off with handling. *Context* 0.5–3.0 mm thick, translucent white becoming pale yellow-brown at apex of stipe. *Hymenophore* dull tan brown initially darkening slightly as spores mature, sublamellate to labyrinthine loculate, compact, contorted/wrinkled and intervenose, forming irregular labyrinthine chambers 0.5–2 mm diam. *Stipe-columella* percurrent, 14–36  $\times$  5–8 mm diam, white staining slightly tan brown, densely fibrillose, white in section with brown stains at base, central to slightly asymmetric, solid, robust, equal then expanding into marginate bulbous base that tapers slightly to a point, dry; *veil remnants* apparent as brown fibrils on margin of base, and *partial veil* as a dense white cortina between pellis margin and stipe. *Basal mycelium* not conspicuous. *Odour* mild, not distinctive; *taste* not distinctive.

*Spores* 9.6–11.6(–12.1)  $\times$  7–9.4  $\mu\text{m}$ , mean (11 spores) = 10.8  $\times$  7.9  $\mu\text{m}$ , Q = 1.3–1.6, mean Q = 1.56, golden yellow brown (KOH), broadly ellipsoid, ornamented with irregular, scattered warts, 0.3–0.5  $\mu\text{m}$  high, warts flat topped or rounded; hilar appendage to 1  $\mu\text{m}$ , conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex ornamented. *Basidia* 32.0–36.5  $\times$  6.7–10.2  $\mu\text{m}$ , hyaline, narrowly clavate, 4-spored. *Cystidia* 18.0–32.0  $\times$  7.0–9.5  $\mu\text{m}$ , elongate to cylindrical or narrowly clavate, with yellowish oily contents in KOH, rare. *Hymenophoral trama* 30.0–74.5  $\mu\text{m}$  wide, of interwoven to subparallel, hyaline, inflated hyphae, 5–13  $\mu\text{m}$  diam. *Subhymenium* undifferentiated from trama. *Pileipellis* simplex. Narrow overlying gelatinised layer, 6–15  $\mu\text{m}$  wide, of narrow, parallel hyaline hyphae 2–4  $\mu\text{m}$  diam; *epicutis* well developed, 40–75  $\mu\text{m}$  wide, of interwoven light golden yellow hyphae, 2–6  $\mu\text{m}$  diam with scattered ellipsoid to elongate elements 6–13  $\times$  4–9  $\mu\text{m}$ ; *context* 220–450  $\mu\text{m}$  wide, of interwoven, light golden yellow (KOH), septate hyphae, mostly 2–5  $\mu\text{m}$  diam, intermixed with scattered inflated elements 6–14  $\mu\text{m}$  diam, becoming slightly more inflated towards the hymenium, 18–24  $\mu\text{m}$  diam. *Clamp connections* present in the pileus.

*Habitat & Distribution* — In New South Wales, occurring in dry sclerophyll forest on the high slopes of the Kaputar Plateau among *Brachychiton populneus*, *Eucalyptus albens*, *E. elliptica*, *E. laevopinea* and *Exocarpus cupressiformis*. Fruiting: July.

*Specimens examined*. Known only from type collection.

*Notes* — *Cortinarius basorapulus* may be distinguished by the combination of sporocarps with pale tan brown pileus, distinctively marginate bulbous base that tapers slightly, and

pileipellis simplex. Macroscopically this species resembles descriptions of the sequestrate New Zealand taxon *C. leucocephalus* and sequestrate Australian taxon *C. cunninghamii*, with pale pileus and loculate hymenophore with elongate cells. However, few collections have been made of either species and the notes available for macroscopic characters are limited (Horak 1973, Beaton et al. 1984, Grgurinovic 1997). Examination of type and other material of *C. cunninghamii* in the State Herbarium Adelaide (AD) confirmed the presence of a slender attenuated stipe, subgelatinised hyphae forming the cutis, and spores in the range 9–11  $\times$  5–6.5  $\mu\text{m}$ . *Cortinarius basorapulus* sporocarps appear to be slightly darker brown, with a strongly marginate rather than slender attenuated stipe base, and the spores are more broadly ellipsoid than either *C. cunninghamii* or *C. leucocephalus*.

Analyses of ITS sequences places *C. basorapulus* in a poorly supported section *Percomes* (bootstrap 61%), in a subclade (bootstrap 58%) with the European taxa *C. langei*, *C. nanciensis* and *C. percomis*. A sister subclade with strong support (bootstrap 93%) includes the Australian taxon *C. coelopus*, European taxon *C. papulosus*, and the New Zealand taxon *C. sp PDD77486* (Fig. 1). *Cortinarius delaportei* is nearby but not included in the *Percomes* clade in this analysis.

All species in this clade have a basic pileus colour of a 'variation on brown', a pileipellis simplex, and ellipsoid to elongate spores. However, this group of species does vary in the stipe shape and degree of violet coloration present. The stipe shape is cylindrical in *C. nanciensis* and *C. percomis*, and bulbous in all other taxa; and in *C. coelopus* violet blue coloration is restricted to the pileus margin, in *C. delaportei* and *C. sp PDD77486* violet blue is exclusively in the lamellae and stipe apex, in *C. nanciensis* violet-blue occurs only in the veil at the stipe base, and *C. basorapulus*, *C. langei*, *C. papulosus* and *C. percomis* lack any violet-blue coloration.

### 3. *Cortinarius caesibulga* Vernes, Danks & T. Lebel, *sp. nov.* — MycoBank MB515237; Fig. 2c, 7, 8

Sporocarpia hypogaea vel emergentia, 4–27 mm lata, subglobosa vel irregulariter turbinata, margine plicata; pileus griseocaesius decoloratus ad brunneocaesius, non-viscidus. Velum argentigriseum, tenue, sericeum, persistens. Hymenophorum sublammellatum vel lamellatum contortum et plicatum, initio pallidocinnamomeum, maturitate leviter fuscum. Stipes 9–25  $\times$  2–3 mm, percurrens, solidus, protrudens argenteocaesius, sericeus. Pileipellis bistrata, extus hyphis tenuibus hyalinis vel pallide luteobrunneis gelatinosis, interne hyphis hyalinis inflatis non-gelatinosis. Basidiosporae

asymmetricae, ovatae,  $8.7\text{--}11 \times 4.8\text{--}6.2 \mu\text{m}$ , in KOH pallidocinnamomeae, nodulosis tenuibus  $0.5\text{--}(0.8) \mu\text{m}$  altis. — Typus: *M. Danks*, *J.M. Trappe*, *T. Lebel* & *K. Vernes* KV660 (MEL2331651) (holotypus hic designatus), Australia, New South Wales, off Waterfall Way, near junction with Point Lookout Rd, Plot DS5, 19 July 2007.

**Etymology.** Name refers to the appearance of the sporocarps as 'little bags or dumplings' (L.: caesius = lavender pale blue with grey tinge; bulga = purse or bag).

**Sporocarps** hypogeous to emergent under leaf litter, singly or in small groups. **Pileus**  $2\text{--}18 \times 4\text{--}27$  mm diam, irregularly subglobose to turbinate with a flattened apex, and irregularly folded margin which may be lacerate and seceding slightly in mature specimens, attached to stipe by a persistent cobweb veil. **Pellis** lavender fading to tan-lavender with a silky, silvery sheen, finely fibrillose, dry to moist when fresh but not viscid, not hygrophanous, not bruising, with overlying remnant of a silvery-grey, fibrillose-silky universal veil, easily rubbed off with handling. **Context**  $0.3\text{--}0.8$  mm thick, white to cream. **Hymenophore** pale cinnamon brown initially darkening slightly as spores mature, trama, if noticeable, white to translucent grey; sublammellate to lamellate, compressed, distorted/wrinkled, and intervenose, especially near the apex and stipe. **Stipe-columella** percurrent,  $9\text{--}25 \times 2\text{--}3$  mm diam, silvery lavender, in section white to translucent in younger specimens and very pale greyish lilac in old specimens, central, solid, slender, convoluted, equal or slightly bulbous to base, dry, silky; **partial veil** inconspicuous but present between inrolled margin of pileus and stipe-columella, cortinoid to cottony, concolorous silvery-grey with slight lilac tint (more obvious in younger specimens). **Basal mycelium** inconspicuous. **Odour** mild, not distinctive, though in older specimens becoming more pungent and unpleasant; **taste** slightly farinaceous.

**Spores**  $8.7\text{--}11 \times 4.8\text{--}6.5 \mu\text{m}$ , mean (20 spores) =  $9.6 \times 5.6 \mu\text{m}$ ,  $Q = 1.6\text{--}2.0$ , mean  $Q = 1.82$ , pale cinnamon brown (KOH),

ovoid to ellipsoid, slightly asymmetrical, densely ornamented with isolated nodules to  $0.5\text{--}(0.8) \mu\text{m}$ ; hilar appendage to  $1 \mu\text{m}$ , conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex ornamented. **Basidia**  $26\text{--}39 \times 5\text{--}8 \mu\text{m}$ , hyaline, clavate to cylindrical, thin-walled, with 4 sterigmata. **Cystidia**  $23\text{--}57 \times 6\text{--}11 \mu\text{m}$ , hyaline, narrowly clavate, thin-walled, scattered and never protruding beyond hymenium. **Hymenophoral trama**  $20\text{--}45 \mu\text{m}$  wide, of loosely interwoven to subparallel, hyaline inflated hyphae,  $4\text{--}11 \mu\text{m}$  diam; **subhymenium** undifferentiated from trama. **Pileipellis** duplex. Overlying partially gelatinised layer,  $9\text{--}38 \mu\text{m}$  wide, of narrow parallel, hyaline to pale yellow hyphae,  $2\text{--}4 \mu\text{m}$  diam; **epicutis** narrow,  $18\text{--}30 \mu\text{m}$  wide, integrating with overlying gelatinised layer in parts, of subparallel, hyaline to pale yellow hyphae,  $2\text{--}6 \mu\text{m}$  diam; **hypocutis**  $25\text{--}60 \mu\text{m}$  wide, of interwoven to subparallel, hyaline, inflated hyphae,  $4\text{--}12 \mu\text{m}$  diam intermixed with irregular, hyaline, inflated isodiametric elements,  $14\text{--}39 \times 6\text{--}22 \mu\text{m}$ ; **context**  $65\text{--}225 \mu\text{m}$  wide, of loosely interwoven to subparallel, inflated, septate, elongate, hyaline hyphae  $30\text{--}80 \times 4\text{--}11 \mu\text{m}$  diam. **Clamp connections** present in the pileus.

**Habitat & Distribution** — In northern New South Wales, occurring in dry sclerophyll forest on the high eastern slopes of the New England Plateau among *Allocasuarina littoralis*, *Eucalyptus caliginosa*, *E. dalrympleana* subsp. *heptantha* and *E. radiata* subsp. *sejuncta*; and in southern New South Wales, occurring in mixed forest of *E. cypellocarpa* and *E. sieberii* near Mt Imlay. In Victoria, occurring in wet sclerophyll forest among *E. regnans*. Fruiting: May–July.

**Specimens examined.** AUSTRALIA, **New South Wales**, off Waterfall Way, near Serpentine Nature Reserve, Plot DS6, 20 July 2007, *M. Danks*, *J.M. Trappe*, *T. Lebel* & *K. Vernes* KV715 (NE94638); Off Nungatta Rd, 3.35 km from junction with Imlay Rd, on western side of rd, 31 May 2001, *T. Lebel* & *S. Lewis* TL502A (MEL2310527); Off Laings Rd west, near corner with Reef Rd west, 3 June 2001, *T. Lebel* & *J. Zdravetski* TL621 (MEL2310487); Off Laings Rd west, 1.2 km from junction with Imlay Rd, on eastern side of rd,

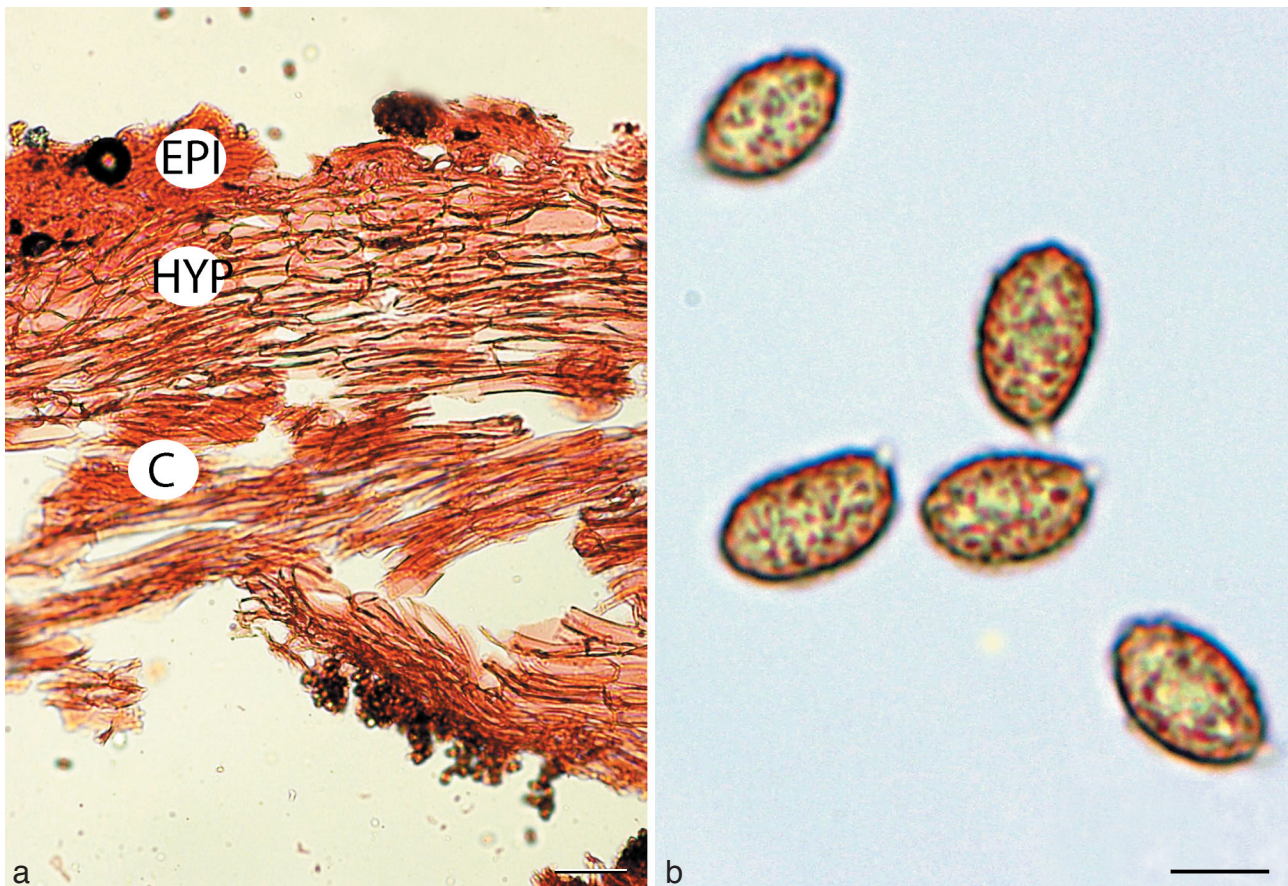


Fig. 7 *Cortinarius caesibulga*. a. Pileipellis; b. spores. — Scale bars: a =  $50 \mu\text{m}$ ; b =  $5 \mu\text{m}$ .

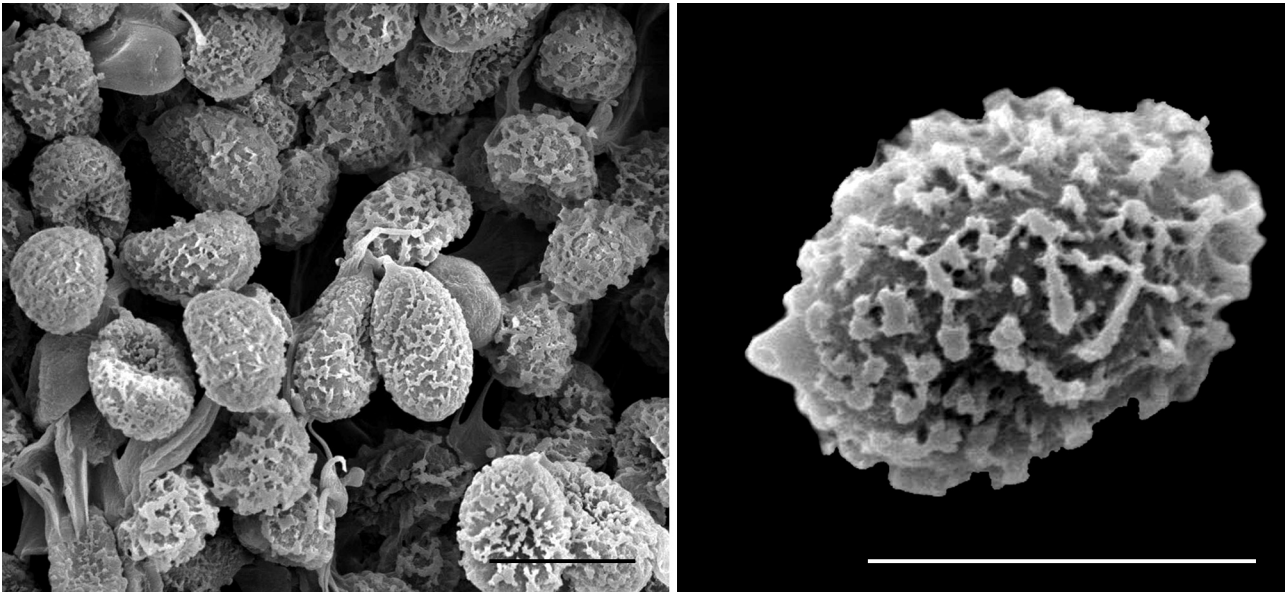


Fig. 8 Scanning electron micrographs of *Cortinarius caesibulga* spores. — Scale bars = 10  $\mu\text{m}$ .

3 June 2001, *J. Zdravevski* TL661 (MEL2314440); Off Imlay Rd to south, 1.05 km west of junction with Brushtail Rd, 30 May 2001, *J. Zdravevski* TL430 (MEL2310509). **Victoria**, Acheron Way, Acheron Gap between Narbethong and Warburton, 29 June 2005, *G.M. Mueller* 7232 (MEL2293662); Dom Dom Saddle, Maroondah Hwy, 23 May 2004, *K. Syme* 1303/04 (MEL2292312); Mt Baw Baw National Park, Mt Erica, Mt Monarch Walk, 80 m from trailhead, 17 May 2003, *A. Francis & T. Lebel* H0904 (PERTH); Nunningong State Forest, Bentleys Plain Rd, Claridge site 104, 26 May 1996, *A. Jumpponen* T18313 (MEL, CANB, OSC130729); Yambulla State Forest, Falkner Rd 3.1 km west of Kallack Rd, 9 July 1996, *A.W. Claridge* H7127 (PERTH).

**Notes** — *Cortinarius caesibulga* is distinguished by the silvery-lavender sporocarps with slender stipe-columella, which has a white context, contorted sublamellate to lamellate hymenophore, and the fine spore ornamentation. Based on analyses of ITS sequence data, *C. caesibulga* belongs in section *Purpurascentes* (Fig. 1.) This species is in a well-supported clade (bootstrap 84 %) with the agaric *C. submagellanicus* (Tasmania), and several misidentified sequences of sequestrate taxa. All of these taxa have some lilac-purple tints to the pileus, though to varying degrees.

The Australian sequence labelled '*C. fragilis* T18313' (AF325559) is unlikely to be the same as the taxon originally described from Chile, instead is here included in the new species *C. caesibulga*. *Cortinarius caesibulga* may be differentiated from *C. fragilis* (Type) by the smaller spores, and sublamellate to lamellate vs elongate labyrinthine hymenophore, and lilac pellis vs whitish with scant lilac tints. The two *C. porphyroideus* collections (NZ8468 and MEL2079347) included in our analyses, require further examination as the sequences appear in quite different clades, in sections *Myxaciium* and *Purpurascentes* respectively. The MEL collection appears to conform to the published description of *C. porphyroideus* (Cunningham 1979), however pileus texture and structure and spore ornamentation make placement of this taxon in *Myxaciium* rather than *Purpurascentes* more likely. As such we suggest that this sequence (DQ328106) should not be included in analyses for this taxon. The NZ collection (*Myxaciium*) has not been examined by the authors. *Cortinarius caesibulga* may be differentiated from *C. porphyroideus* and *C. submagellanicus* by the much less robust stipe, and silvery lilac pellis vs deep purple or purple-brown pellis.

The two Victorian collections of *C. caesibulga*, MEL2293662 and MEL2292312, both have slightly more robust spore ornamentation than the New South Wales collections, however are similar in all other characters.

#### 4. *Cortinarius cinereoroseolus* Danks, T. Lebel & Vernes, *sp. nov.* — MycoBank MB515238; Fig. 2d, 9, 10

Sporocarpia hypogaea, 11–24 mm lata, subglobosa vel irregulariter pyriformia, margine plicata; pileus eburneus vel leviter nitens pallide roseolilacinus-cinereus, non viscidus. Velum pallidocinereum tenue, sericeum. Hymenophorum loculatum, initio pallidobrunneum, maturitate fuscocinnamomeum. Stipes 5–11  $\times$  3–6 mm, truncatus vel percurrens, basi bulbosa protrudens, albus, sericeus. Pileipellis tenuis, hyphis latis hyalinis non-gelatinosis. Basidiosporae asymmetricae, late ovatae, 7–8.9  $\times$  5.1–6.4  $\mu\text{m}$ , in KOH cinnamomeae, nodulosis irregularibus et lineis brevis robustis, < 1.5  $\mu\text{m}$  altis. — Typus: *M. Danks, J.M. Trappe, T. Lebel & K. Vernes* KV529 (MEL2331646) (holotypus hic designatus), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot GW2, 17 July 2007.

**Etymology.** Name refers to the shiny-pale pink colour of the sporocarps (L.: cinereo = greyish; roseolus = pale pink).

**Sporocarps** hypogeous under leaf litter, fruiting in large groups. **Pileus** 11–27  $\times$  11–24 mm diam, irregularly subglobose to pyriform, slightly plicate margin, attached to stipe by a persistent, inconspicuous, white to silvery-grey veil. **Pellis** cream with pale pink-lilac-grey, slightly shiny, finely fibrillose, smooth, dry to moist when fresh but not viscid, not hygrophanous, not bruising, with overlying remnant pale grey, silky universal veil, easily rubbed off with handling. **Context** 0.3–0.8 mm thick, white to cream. **Hymenophore** pale brown initially, becoming dark cinnamon brown, trama, if noticeable, pale brown to dark grey-brown; loculate, chambers empty, regular, rounded to slightly elongate. **Stipe-columella** a truncate to percurrent columella tapering slightly from a bulbous inserted base towards the apex, 5–11  $\times$  3–6 mm diam, white to translucent in section, central, more or less terete, white, dry, silky, solid, fibrous, base bulbous protruding up to 3 mm below pileus; **partial veil** inconspicuous but present between inrolled pileus margin and bulbous base, cortinoid, concolorous pale grey. **Basal mycelium** inconspicuous, white. **Odour** faintly floral or of chlorine; **taste** not distinctive.

**Spores** 7–8.9  $\times$  5.1–6.4  $\mu\text{m}$ , mean (20 spores) = 8.0  $\times$  5.7  $\mu\text{m}$ , Q = 1.3–1.6, mean Q = 1.45, cinnamon brown (KOH), broadly ovoid, slightly asymmetrical, ornamented with irregular nodules pegs and some short broad lines, nodules robust to 1.5  $\mu\text{m}$  tall, usually angular; hilar appendage to 1  $\mu\text{m}$ , conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex ornamented. **Basidia** 28–40  $\times$  7–9  $\mu\text{m}$ , hyaline, clavate to cylindrical, thin-walled, with 4 sterigmata. **Cystidia** 20–26  $\times$  7–11  $\mu\text{m}$ , hyaline, clavate, thin-walled, scattered and never protruding

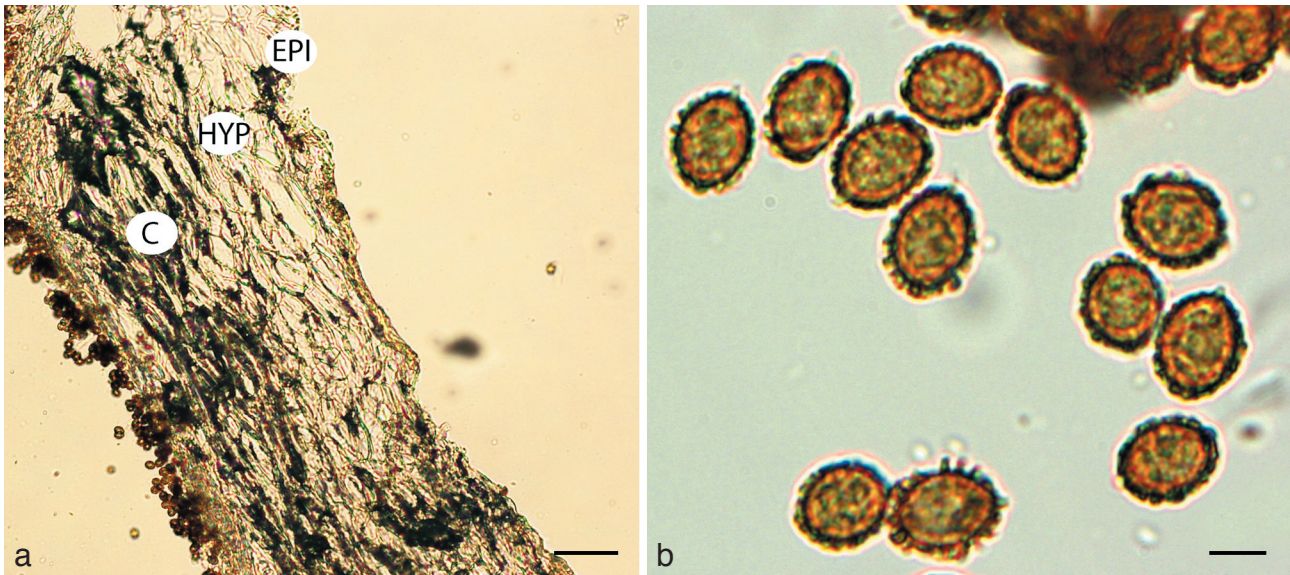


Fig. 9 *Cortinarius cinereoroseolus*. a. Pileipellis; b. spores. — Scale bars: a = 50 µm; b = 5 µm.

beyond hymenium. *Hymenophoral trama* 30–110 µm wide, of scattered inflated round and elongated, hyaline, gelatinised, thick-walled hyphae, 8–22 × 55–70 µm; subhymenium 20–35 µm undifferentiated from trama. *Pileipellis duplex*. *Epicutis* a very thin layer, 5–11 µm wide, of gelatinised, parallel, hyaline to pale yellow narrow hyphae, 3–5 µm diam; *hypocutis* 30–90 µm wide, difficult to distinguish from the underlying context, of non-gelatinised, subglobose to ellipsoid, hyaline hyphae, 8–26 µm diam × 6–30 µm long; *context* up to 350 µm wide, of non-gelatinised, subparallel, inflated hyaline hyphae, 10–30 µm wide. *Clamp connections* present in the pileus and hymenial tissues.

**Habitat & Distribution** — In New South Wales, found in the sub-alpine and high slopes areas of the Kaputar Plateau, in a grassy woodland community dominated by *Eucalyptus dalrympleana*, *E. pauciflora* and *Poa sieberiana* with scattered *Acacia melanoxylon*, *Acacia* sp., *Hibbertia obtusifolia*, *Lomatia arborescens*, *Monotoca scaparia*, *Olearia rosemanifolia* and *Pultanea satulosa*. Also found in wet sclerophyll forest dominated by *E. dalrympleana*, *E. laevopinea* and *E. viminalis* with an understorey dominated by *Acacia melanoxylon*, *Blechnum cartilagineum*, *Coprosma quadrifida*, *Cyathea australis*, *Lomandra multiflora*, *Lomatia arborescens* and *Poa sieberiana*. Fruiting: July.

**Specimen examined.** AUSTRALIA, New South Wales, Mt Kaputar, Kaputar Rd, Plot WS3, 17 July 2007, M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV610 (NE94637).

**Notes** — *Cortinarius cinereoroseolus* may be differentiated from other Australian sequestrate *Cortinarius* species by the definite pinkish tint to the sporocarp when fresh (note lilac tones are present) and slightly more robust and irregular spore ornamentation. This species also belongs in section *Purpurascetes*.

Analysis of ITS data places *C. cinereoroseolus* in a subclade (bootstrap 69 %) with two undescribed sequestrate taxa, sister to a well-supported subclade including *C. caesibulga* and *C. submagellanicus* (bootstrap 84 %) and an unsupported subclade with *C. australis*, *C. chalybaeus*, *C. porphyropus*, *C. purpurascens* and *C. purpurascens* var. *largusoides* (Fig. 1). While the colour, texture and form of the sporocarps vary, all of the taxa in the *C. cinereoroseolus* subclade share a similar pileus structure, of a thin epicutis of subgelatinised, narrow hyaline to pale yellow hyphae overlying a hypocutis and context of inflated hyphae, and robust spore ornamentation. *Cortinarius* sp. H0920 & H4770 and *Cortinarius* sp. H1194 share a smooth silky pileus, labyrinthine loculate and yellowish to cinnamon hymenophore, and ellipsoid spores with robust warts and nodules up to 0.8–1

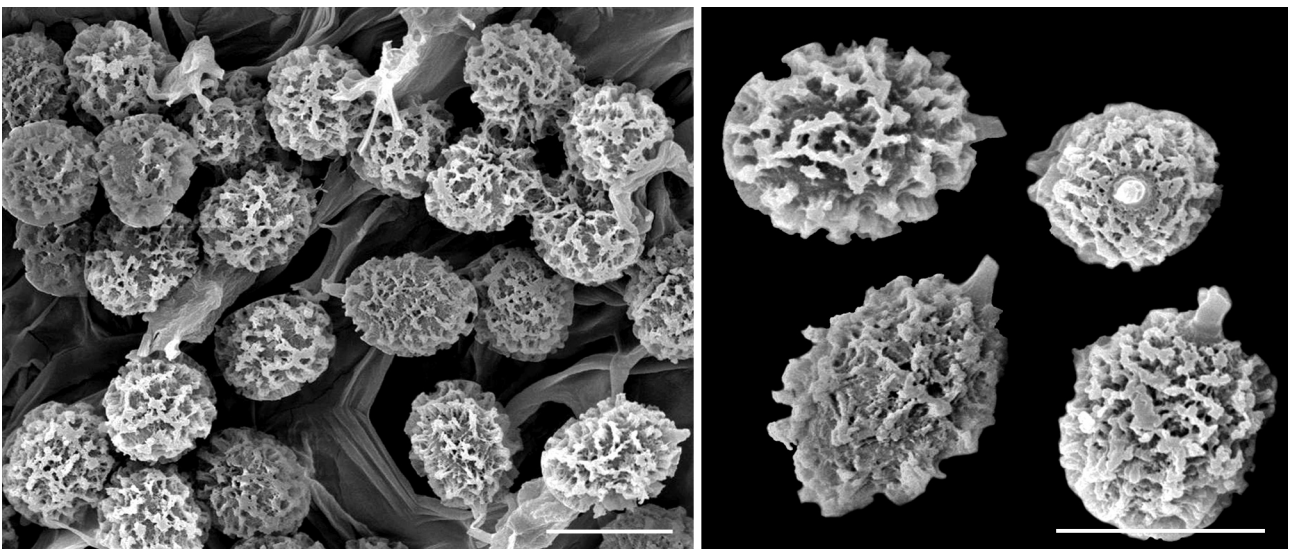


Fig. 10 Scanning electron micrographs of *Cortinarius cinereoroseolus* spores. — Scale bars = 10 µm.

$\mu\text{m}$  high. They differ in the colour of the pileus and form of the stipe-columella: pale greyish silky violet to purplish brown and narrow percurrent in *Cortinarius* sp. H0920 & H4770, and dull, pale greyish brown and narrow percurrent with bulbous base in *Cortinarius* sp. H1194.

**5. *Cortinarius kaputarensis*** Danks, T. Lebel & Vernes, *sp. nov.*  
— MycoBank MB515239; Fig. 2e, 11, 12, 13

Sporocarpia hypogaea vel emergentia, 15–25 mm lata, conica vel subglobulosa, margine involuta; pileus luteobrunneus vel auranteobrunneus subviscidis. Velum parziale luteum, crassum, persistens et veli universalis vestigium fuscobrunneum fibrillosum persistens. Hymenophorum sublamellatum vel labyrinthiforme loculatum contortum, juventute vivide cinnamomeus, maturitate cinnamomeum. Stipes 15–50  $\times$  3–8 mm, percurrens, protrudens, solidus, gracilis, equalis, pallide luteus, glabrus, non-viscidus; contextus eburneus vel pallide luteus, centro fibrillosus. Pileipellis bistrata, externe hyphis auranteobrunneis, interne hyphis fusco-auranteobrunneis. Basidiosporae asymmetricae, ovatae vel amygdalina, 9.9–12.1  $\times$  5.4–7.4  $\mu\text{m}$ , in KOH cinnamomeae, nodulosi irregularibus robustis < 1.5  $\mu\text{m}$  altis. — Typus: M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV603 (holo MEL2331649 (holotypus hic designatus); iso NE94644), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot WS3, 17 July 2007.

*Etymology.* Name refers to the type locality, Mt Kaputar.

*Sporocarps* hypogeous to emergent under leaf litter, in a small group. *Pileus* 12–30  $\times$  15–25 mm diam, conical to subglobose, occasionally with a slightly flattened apex, and inrolled margin. *Pellis* yellow-brown to orange-brown, smooth, subviscid when fresh, not hygrophane, not bruising, with scattered universal veil remnants of darker brown fibrils overlying most of the surface, not easily rubbed off with handling. *Context* 0.3–2.0 mm thick, rapidly thinning from disc to margin, translucent cream. *Hymenophore* bright cinnamon brown initially, darkening slightly as spores mature to drab cinnamon brown, sublamellate to loculate, compact, forming irregular, contorted labyrinthine chambers 0.5–1 mm diam, remaining completely enclosed. *Stipe-columella* percurrent, 15–50  $\times$  3–8 mm diam, pale yellow, smooth, moist but not viscid when fresh, cream to pale yellow in section, with central core of translucent less fibrillose tissue, central, slender, equal; *partial veil* cottony, yellow, persistent; *universal veil* remnants present as scattered dark brown fibrils at base and lower half of stipe. *Basal mycelium* yellow. *Odour* mild, not distinctive; *taste* not distinctive.

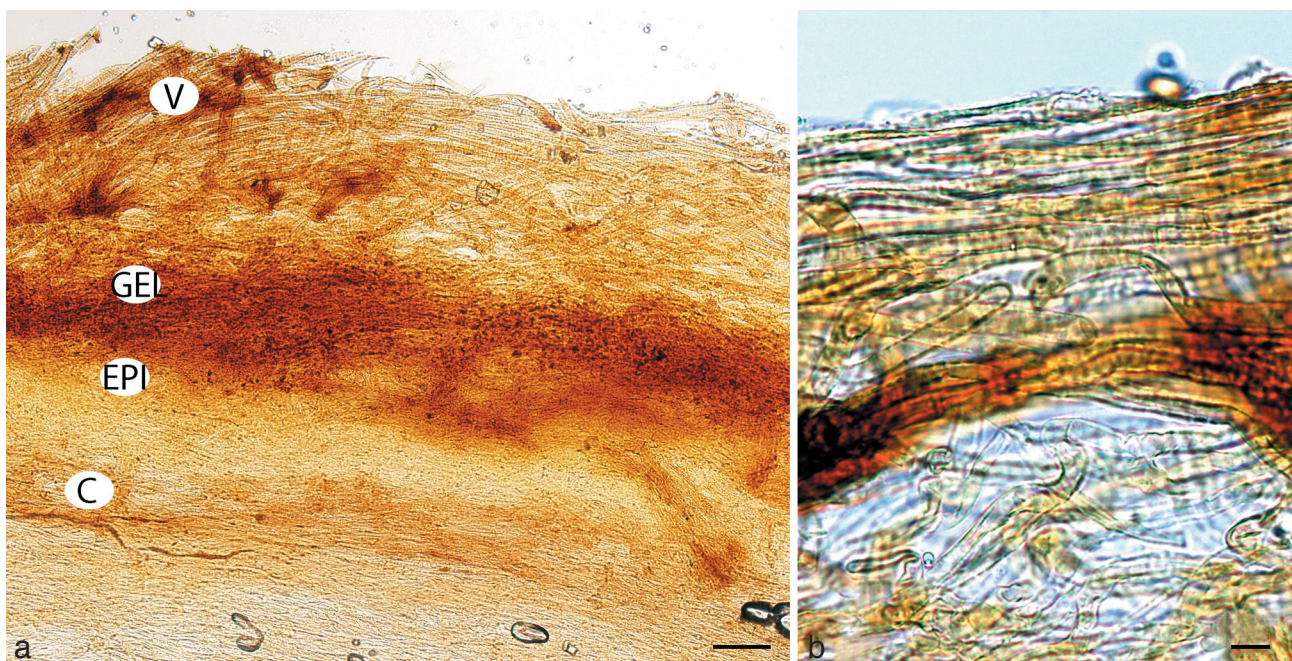
*Spores* 9.9–12.1  $\times$  5.4–7.4  $\mu\text{m}$ , mean = 11.2  $\times$  6.1  $\mu\text{m}$ , Q = 1.5–2.2, mean Q = 1.91, cinnamon brown (KOH), ovoid to almond-shaped, asymmetrical, ornamented with isolated, irregular, rounded nodules, to 1.5  $\mu\text{m}$  tall; hilar appendage to 1.5  $\mu\text{m}$ , conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex rostrate, apex ornamentation less conspicuous. *Basidia* 19–37(–40)  $\times$  6–9  $\mu\text{m}$ , cylindrical to clavate, hyaline, mostly 4-, rarely 2-spored. *Cystidia* 18.5–26.5  $\times$  (7–)10–11  $\mu\text{m}$ , clavate, hyaline, abundant. *Hymenophoral trama* 26–57  $\mu\text{m}$  wide, of interwoven, hyaline, irregularly inflated hyphae, 4–9  $\mu\text{m}$  diam, with scattered to abundant inflated elements, to 12–21  $\mu\text{m}$  diam. *Subhymenium* undifferentiated from trama. *Pileipellis* simplex. *Veil* 110–220  $\mu\text{m}$  wide, of orange-brown pigmented (KOH), finely to zebra encrusted hyphae, 4–11  $\mu\text{m}$  diam, appearing undulating in outline; overlying a gelatinised layer 30–70  $\mu\text{m}$  wide, of darker orange-brown hyphae, 2–7  $\mu\text{m}$  diam; *epicutis* 40–85  $\mu\text{m}$  wide, of interwoven to parallel, hyaline to pale yellow hyphae, 3–5  $\mu\text{m}$  diam; *context* 140–370  $\mu\text{m}$  wide, of densely compacted interwoven to sub-parallel, hyaline hyphae, 3–7  $\mu\text{m}$  diam with rare sinuous dark orange-brown hyphae 2–3.5  $\mu\text{m}$  diam, and scattered inflated elements, 9–17  $\mu\text{m}$  diam becoming more common towards the hymenium. *Clamp connections* present and obvious in the pileus.

*Habitat & Distribution* — In New South Wales, occurring in wet sclerophyll forest on the high slopes of the Kaputar Plateau among *Eucalyptus dalrympleana*, *E. laevopinea* and *E. viminalis*. Fruiting: July.

*Specimens examined.* Known only from type.

*Notes* — No other species of Australian sequestrate *Cortinarius* has the combination of yellow-brown to orange-brown sub-viscid pileus, persistent bright yellow cottony cortina, pale yellow stipe, and bright cinnamon brown sublamellate to loculate hymenophore. The yellowish brown pigmented veil hyphae, with striped to crustose encrustations are also distinctive, though they do occur in other *Cortinarius* species.

The bright pigments of sporocarp, veil and basal mycelium are characteristic of section *Dermocybe*. However, analyses of ITS sequences suggests placement in a poorly supported (bootstrap 62 %) section *Phlegmacium* subclade, with the Australian species *C. austrovaginat* and *C. sinapicolor* and a sister taxon of the European *C. croceus*, in a poorly supported (bootstrap



**Fig. 11** *Cortinarius kaputarensis*. a. Pileipellis; b. undulating hyphae of outer pellis. — Scale bars: a = 50  $\mu\text{m}$ ; b = 10  $\mu\text{m}$ .

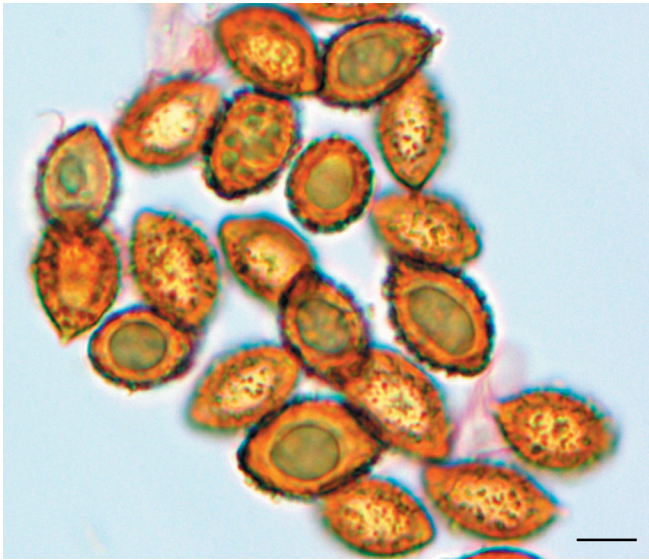


Fig. 12 *Cortinarius kaputarensis* spores. — Scale bar = 5  $\mu$ m.

50 %) broader section *Dermocybe* clade (Fig. 1). *Cortinarius austrovaginatus* and *C. sinapicolor* share a glutinous pileus which *C. kaputarensis* and *C. croceus* lack, but all species vary considerably in pileus colour and stipe shape. *Cortinarius austrovaginatus* has a vinaceous-brown pileus, marginate bulbous stipe base, and thick white universal veil, *C. sinapicolor* has a bright yellow pileus and veil and marginate bulbous stipe base, and *C. croceus* has a yellowish brown pileus, and a yellowish with olive brown barely bulbous stipe (Moser & Horak 1975, Garnica et al. 2003). *Cortinarius croceus* is a pine associate and *C. austrovaginatus* a *Nothofagus* associate whilst *C. kaputarensis* and *C. sinapicolor* are wet *Eucalyptus* associates.

In all preliminary analyses with larger datasets and the analysis presented here, *C. sinapicolor* remained one of the closest taxa to *C. kaputarensis*. *Cortinarius kaputarensis* differs from *C. sinapicolor* in the yellow-brown to orange-brown instead of bright yellow pileus, and lacks the thick glutinous epicutis over both pileus and stipe of the latter species.

**6. *Cortinarius maculobulga* Danks, T. Lebel & Vernes, sp. nov.** — MycoBank MB515240; Fig. 2f, 14, 15

Sporocarpia hypogaea, 10–42 mm lata, subglobosa vel irregulariter turbinate; pileus albus vel eburneus maculatus brunneolus, variabilis viscidus. Velum album vel pallidocinereum, tenue, persistens. Hymenophorum loculatum, juventute pallidocinnamomeum, maturitate fuscocinnamomeum. Stipes 8–35  $\times$  2–6 mm, truncatus vel percurrentis, solidus, basi bulbosus, albus vel eburneus, viscidus; contextus albus vel flavescens. Pileipellis monostrata, hyphis tenuibus hyalinis gelatinosis. Basidiosporae asymmetricae, ovatae, 12.6–14  $\times$  6.3–7.8  $\mu$ m, in KOH cinnamomeae, verrucis tenuibus 0.3–0.5  $\mu$ m altis. — Typus: M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV532 (MEL2331647) (holotypus hic designatus), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot GW2, 16 July 2007.

*Etymology.* Name refers to mottled white-brown colour of the sporocarps (L: maculata = mottled; bulga = purse or bag).

*Sporocarps* hypogeous under leaf litter, fruiting singly or in large groups. *Pileus* 10–23  $\times$  10–42 mm diam, irregularly subglobose to pyriform or turbinate with flattened or convex apex, completely enclosing hymenophore. *Pellis* white to cream mottled with brown patches, smooth, moist to viscid overall or in patches near base, not hygrophanous, not bruising, with patchy overlying remnant veil, white to pale grey, easily rubbed off with handling. *Context* 0.5–1.5 mm thick, translucent white to cream. *Hymenophore* pale cinnamon brown initially becoming dark cinnamon brown, trama, if noticeable, pale brown to dark brown; loculate, chambers empty, irregular, slightly elongate to labyrinthine. *Stipe-columella* a truncate to percurrent columella tapering slightly from a bulbous exerted base towards the apex, 8–35  $\times$  2–6 mm diam, white to translucent yellow in section, central or slightly eccentric, white to cream, viscid, solid, base bulbous, somewhat marginate, 5–11 mm diam, protruding up to 4 mm below pileus; *universal veil* remnants apparent as patchy white to pale grey, viscid fibrils; *partial veil* inconspicuous, thin membranous, connecting inrolled margin and stipe base, white to cream coloured, dry. *Basal mycelium* inconspicuous, white. *Odour* faintly spicy-sweet; *taste* not distinctive.

*Spores* 12.6–14  $\times$  6.3–7.8  $\mu$ m, mean = 13.5  $\times$  7.2  $\mu$ m, Q = 1.8–2.0, mean Q = 1.94, cinnamon brown (KOH), ovoid, ornamented with fine, rounded, isolated warts, 0.3–0.5  $\times$  0.2–0.3  $\mu$ m; hilar appendage to 1  $\mu$ m, conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex ornamented. *Basidia* 37–40  $\times$  9–12  $\mu$ m, hyaline, clavate to cylindrical, thin-walled, with 4 sterigmata. *Cystidia* 15–38  $\times$  4–8  $\mu$ m, hyaline, clavate, thin-walled, scattered and never protruding beyond hymenium.

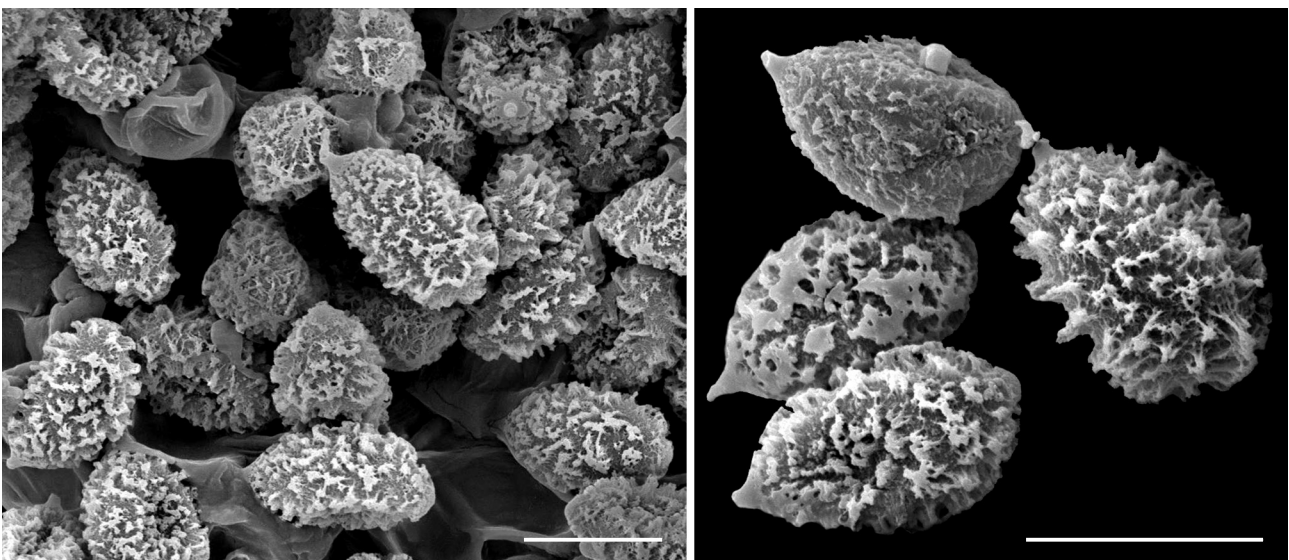


Fig. 13 Scanning electron micrographs of *Cortinarius kaputarensis* spores. — Scale bars = 10  $\mu$ m.



*Hymenophoral trama* 45–195 µm wide, of interwoven, hyaline, somewhat gelatinised hyphae 2–5(–8) µm diam, with inflated elements 4–16 × 5–18 µm. *Subhymenium* undifferentiated from trama. *Pileipellis* simplex. *Epicutis* narrow, 15–45 µm wide, of patchy upright hyphal tips, becoming interwoven and subparallel below, hyphae 3–6 µm diam; *context*, 70–320 µm broad, of gelatinised, hyaline hyphae, 2–8 µm diam. *Clamp connections* present in the pileus.

**Habitat & Distribution** — In New South Wales, occurring in sub-alpine grassy woodland on the Kaputar Plateau among *Eucalyptus dalrympleana*, *E. pauciflora* and *E. viminalis*. Fruiting: July.

**Specimens examined.** AUSTRALIA, New South Wales, Mt Kaputar, Kaputar Rd, Plot GW1, 16 July 2007, M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV510 (NE94640); Mt Kaputar, Kaputar Rd, Plot GW1, 16 July 2007, M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV511 (NE94641).

**Notes** — *Cortinarius maculobulga* may be distinguished from other Australian sequestrate *Cortinarius* species by the subglobose to pyriform white to cream sporocarps mottled with brown patches, and largish spores with minute warts. Analyses

of ITS sequences places this species in a poorly supported (bootstrap 52 %) *Rozites* 'A' clade with three other southern hemisphere species, Australian *C. vinaceolamellatus*, New Zealand *C. subcastanellus* and sequestrate Argentinean taxon *C. holojanthinus*. The Australian species *C. submeleagris* is not included in this clade in the analysis presented, however in earlier analyses it did group with these taxa. A second clade of *Rozites* 'B' with strong support (bootstrap 97 %), including the European and Asian species *C. caperatus*, *C. emodensis* and *C. similis* is apparently distinct to this first group (Fig. 1).

Species of *Rozites* have velar remnants or scales on the pileus (which may disappear in older specimens), a slightly viscid to glutinous pileus, and a membranous partial veil. *Cortinarius maculobulga* appears to lack the distinct velar remnants apparent on the pileus of many other *Rozites* taxa, though the veil is somewhat membranous. This species also differs from other *Rozites* taxa in having a pileipellis simplex rather than duplex. Species in the *Rozites* 'A' clade have either glutinous to viscid brownish (*C. subcastanellus*, *C. submeleagris*, *C. maculobulga*) or silver-greyish purple (*C. holojanthinus* and *C. vinaceolamellatus*) pilei. *Cortinarius maculobulga* and *C. subcastanellus*

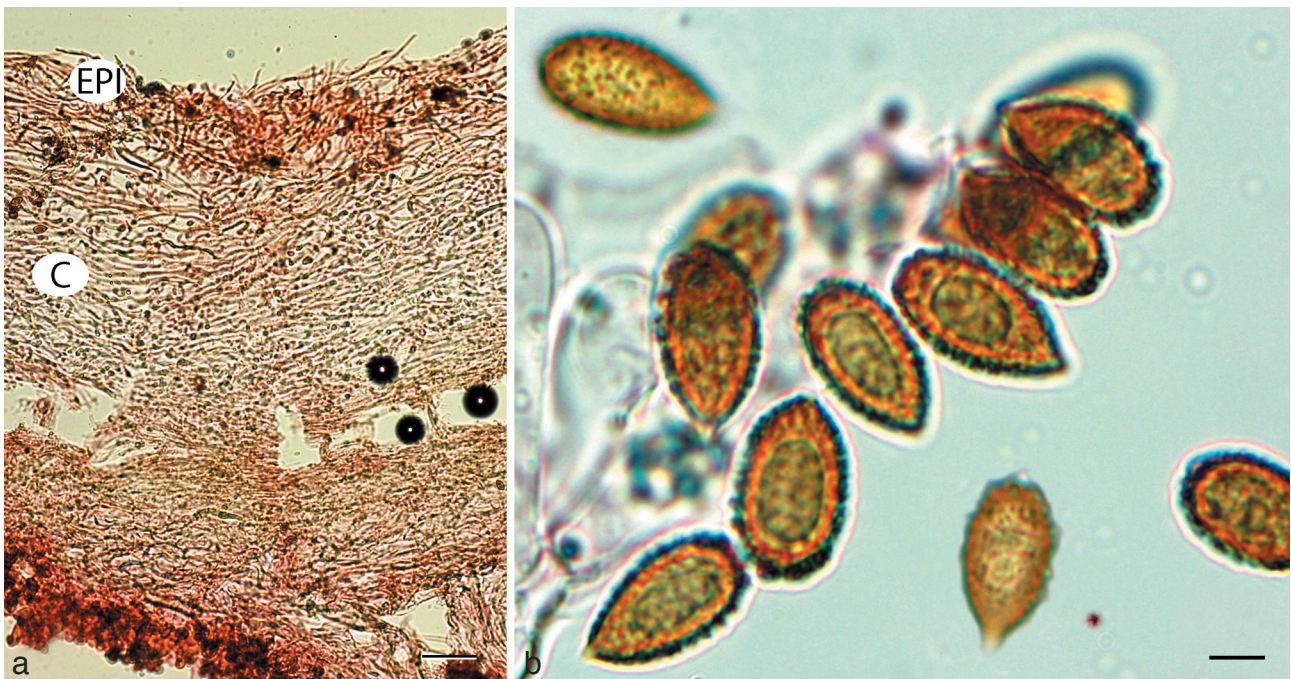


Fig. 14 *Cortinarius maculobulga*. a. Pileipellis; b. spores. — Scale bars: a = 50 µm; b = 5 µm.

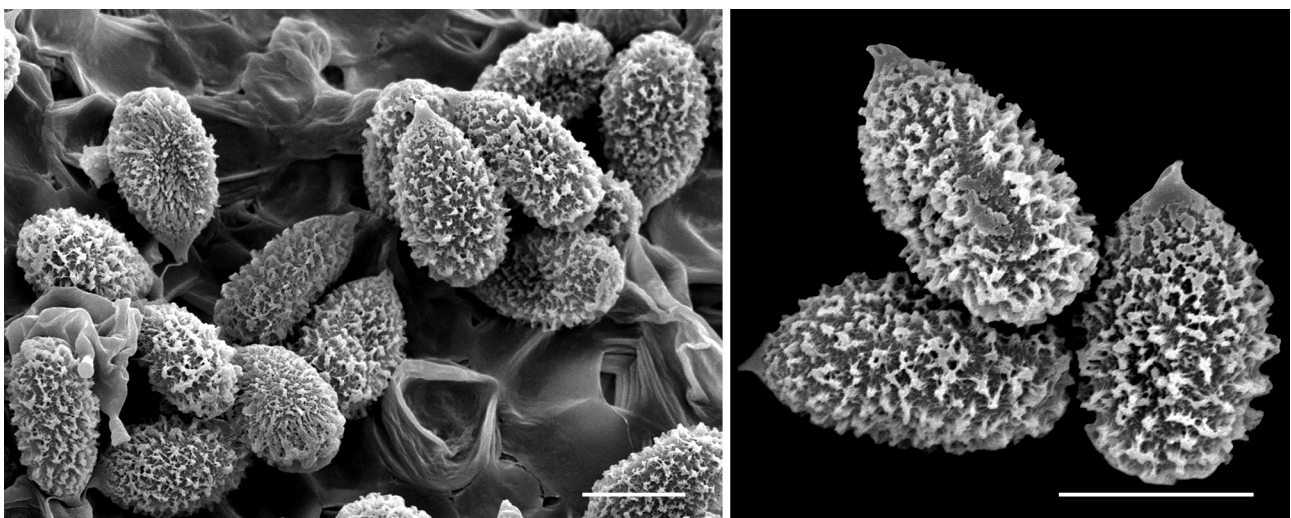


Fig. 15 Scanning electron micrographs of *Cortinarius maculobulga* spores. — Scale bars = 10 µm.

appear to lack any purple tints to the lamellae/hymenophore, whereas *C. holojanthinus*, *C. submeleagris* and *C. vinaceolamellatus* all have at least some purple tints when young.

There is no apparent pattern in plant associates, as *C. holojanthinus*, *C. subcastanellus* and *C. submeleagris* are all *Nothofagus* associates, and *C. maculobulga* and *C. vinaceolamellatus* are eucalypt associates.

**7. *Cortinarius nebulobrunneus*** Danks, T. Lebel & Vernes, *sp. nov.* — MycoBank MB515241; Fig. 2g, 16, 17

Sporocarpia hypogaea vel emergentia, 22–45 mm lata, convexa apicibus complanata, margine laevia; pileus ferrugineus vel brunneus non-viscidis. Velum album, crassum, persistens. Hymenophorum sublamellatum vel labyrinthiforme loculatum contortum, vivide cinnamomeum. Stipes 40–55 × 5–12 mm, percurrans, protrudens, solidus, robustus, basi leviter bulbosus, albus, glaber, non-viscidus; contextus albus. Pileipellis bistrata, extus hyphis tenuibus hyalinis, interne hyphis luteobrunneis non gelatinosis. Basidiosporae asymmetricae, elongatae ellipsoidea, 9.0–11.9 × 5.5–6.5 µm, in KOH pallide luteae, nodulosis irregularibus tenuibus 0.3–0.5 µm altis. — *Typus*: M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV588 (holo MEL2331648 (holotypus hic designatus); iso NE94643), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot GW3, 17 July 2007.

*Etymology.* Name refers to the white 'bloom' universal veil overlying the brown pileus (L.: nebulosus = foggy or misty; brunnea = brown).

*Sporocarps* hypogeous to emergent under leaf litter, in a small group. *Pileus* 13–27 × 22–45 mm diam, strongly convex, occasionally with a flattened apex, and smooth margin. *Pellis* light brown-orange to brown, finely fibrillose, viscid, not hygrophanous, not bruising, sometimes with a white remnant of veil on the disc appearing as a white 'bloom', easily rubbed off with handling. *Context* 0.8–3.0 mm thick, rapidly thinning from disc to margin, translucent yellow-brown, slightly waxy texture. *Hymenophore* bright cinnamon brown at all stages, sublamellate to loculate, compact, forming irregular, contorted labyrinthine chambers 0.3–1 mm diam. *Stipe-columella* percurrent, 40–55 × 5–12 mm, white slightly translucent, somewhat waxy texture, smooth, moist but not viscid when fresh, white in section, central, solid, robust, equal or sometimes expanding into slightly bulbous base; *partial veil* remnants inconspicuous, as fine white cottony cortina between *pellis* margin and *stipe*. *Basal mycelium* not conspicuous. *Odour* mild, not distinctive; *taste* not distinctive.

*Spores* 9.0–11.9 × 5.5–6.5 µm, mean (15 spores) = 9.9 × 5.9 µm, Q = 1.6–1.8, mean Q = 1.74, pale yellow (KOH), elongate ellipsoid, asymmetric, ornamented with fine, scattered, irregular, flat-topped or rounded warts, 0.3–0.5 µm high; hilar appendage to 1 µm, inconspicuous, tapering; spores inamyloid non-dextrinoid; apex ornamented. *Basidia* 25–28(–30) × 5–8

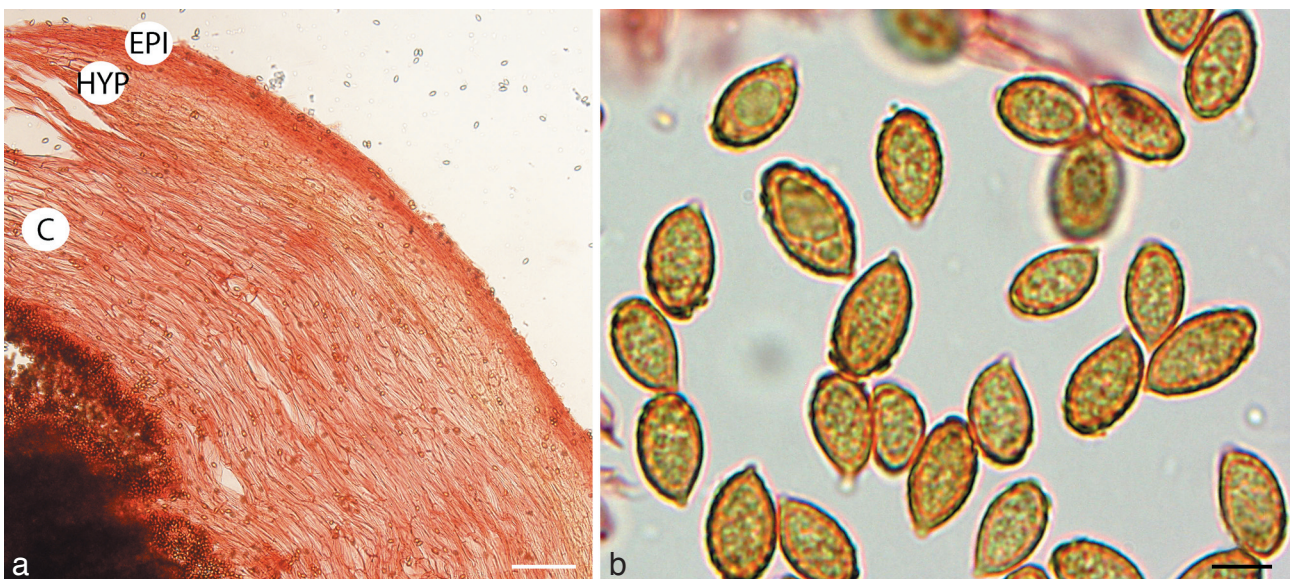


Fig. 16 *Cortinarius nebulobrunneus*. a. Pileipellis; b. spores. — Scale bars: a = 50 µm; b = 5 µm.

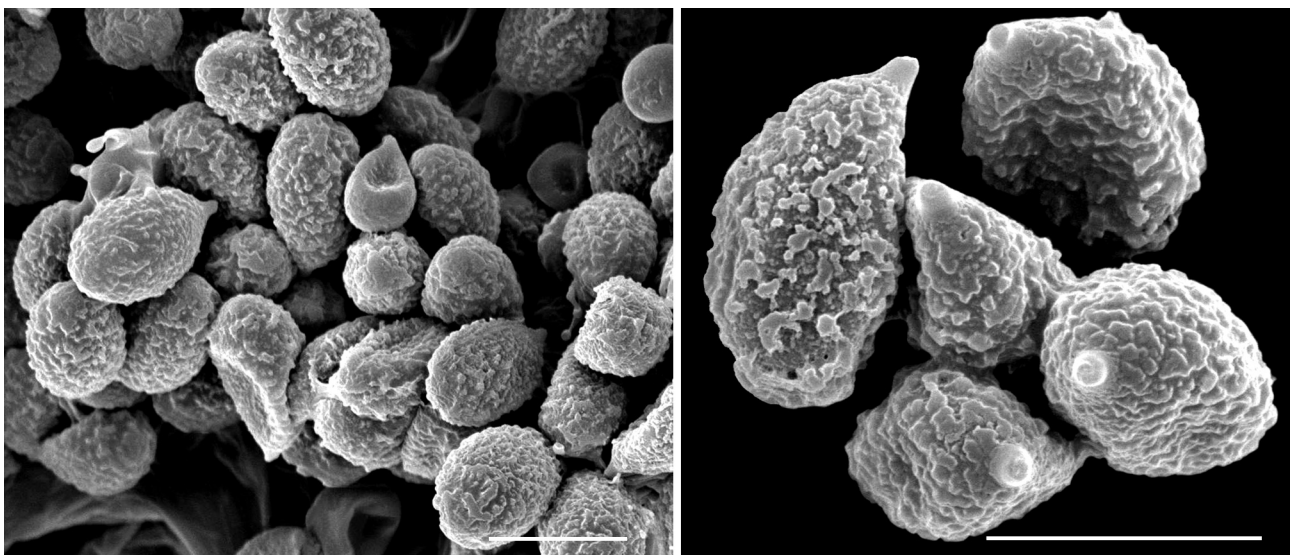


Fig. 17 Scanning electron micrographs of *Cortinarius nebulobrunneus* spores. — Scale bars = 10 µm.

$\mu\text{m}$ , elongate cylindrical to narrowly clavate, hyaline, 4-spored. *Cystidia* not observed. *Hymenophoral trama* 20–45  $\mu\text{m}$  wide, of interwoven hyaline hyphae 2–3  $\mu\text{m}$  diam, with occasional inflated elements 10–17  $\mu\text{m}$  diam; *subhymenium* undifferentiated from trama. *Pileipellis* duplex. *Epicutis* narrow, 15–25  $\mu\text{m}$  wide, of interwoven, gelatinised hyaline hyphae 2–3  $\mu\text{m}$  diam; *hypocutis* 25–75  $\mu\text{m}$  wide, of light golden brown, subglobose to ellipsoid inflated hyphae mostly 6–13  $\mu\text{m}$  diam  $\times$  8–48  $\mu\text{m}$  long; *context* 100–300  $\mu\text{m}$  wide, of mostly hyaline hyphae 4–6  $\mu\text{m}$  diam, subparallel with patches of inflated elements up to 12  $\mu\text{m}$  diam  $\times$  30–45  $\mu\text{m}$  long. *Clamp connections* present in the pileus and hymenophoral trama.

**Habitat & Distribution** — In New South Wales, occurring in sub-alpine grassy woodland among *Eucalyptus dalrympleana*, *E. pauciflora* and *E. viminalis*. Fruiting: June – July.

**Specimen examined.** AUSTRALIA, New South Wales, Coolangubra NP, Waratah Rd 2.1 km NE of junction with Coolangubra Forest Way, A.W. Claridge Trappe 18741, 2 June 1996 (CANB, MEL, OSC130731).

**Notes** — *Cortinarius nebulobrunneus* is distinguished by the combination of brown *pellis* with white bloom of universal veil, sublammellate to loculate hymenophore and robust stipe-columella. The texture of the sporocarp is also distinctive, being slightly waxy. Analysis of ITS sequences places *C. nebulobrunneus* in a well-supported clade (bootstrap 100 %) of species in section *Pseudotriumphantes*, with *C. iringa*, *C. rapaceus* var. *luridus* and an undescribed sequestrate *Cortinarius* sp. H6558 (Fig. 1). In this current analysis, although lacking bootstrap support, other section *Pseudotriumphantes* species are sister taxa, *C. alboaggregatus* and *C. pseudotriumphans*. *Cortinarius austrocyranites* is also in this clade, though currently placed in section *Phlegmacium*. All of these taxa are from the southern hemisphere, and except for *C. nebulobrunneus* and *C. sp. H6558*, are associates of *Nothofagus*. All taxa have brownish sporocarps, a pileipellis duplex, and spores with sparse minute ornamentation.

**8. *Cortinarius sinapivelus* Danks, T. Lebel & Vernes, sp. nov.**  
— MycoBank MB515242; Fig. 2h, 18a, b, 19

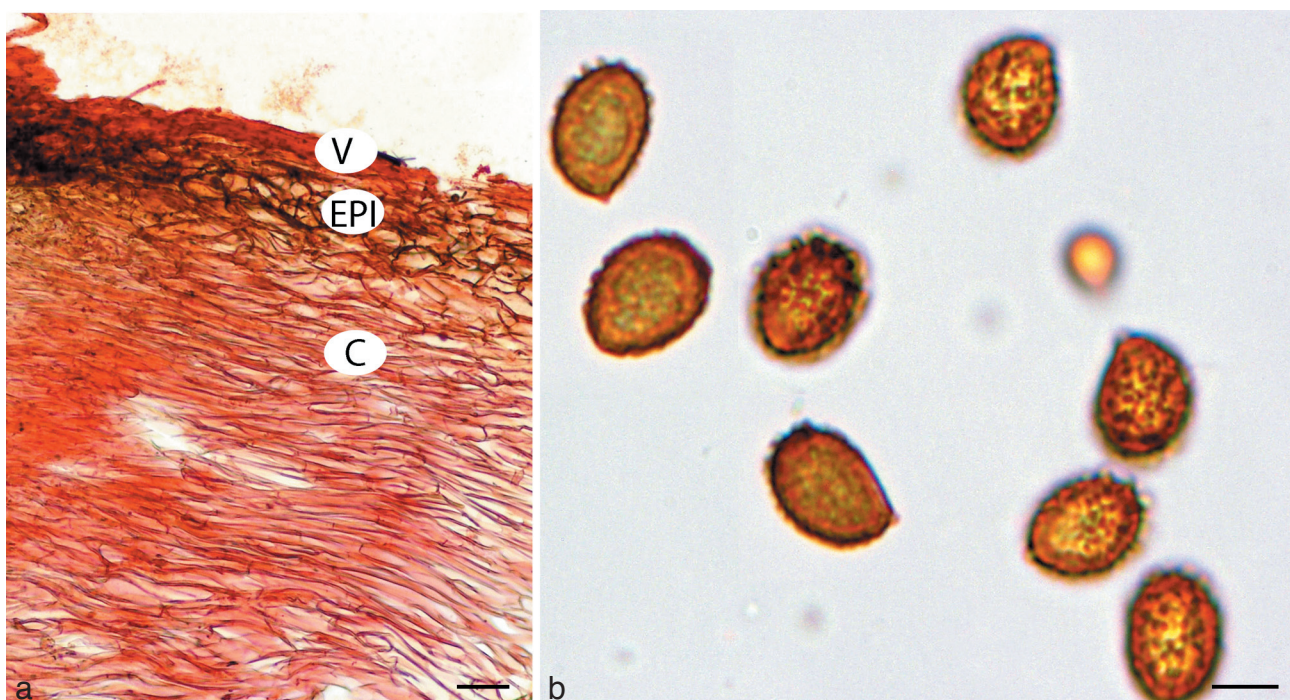
Sporocarpia hypogaea vel emergentia, 12–21 mm lata, convexa vel subglobosa apicibus complanata, margine leviter plicata. Pileus brunneolus non

viscidus. Velum luteum, crassum, persistens. Hymenophorum sublammellatum vel lamellatum contortum et plicatum, juventute pallidocinnamomea, maturitate leviter fuscum. Stipes 18–35  $\times$  6–8 mm, percurrentes, protrudens, solidus, robustus, vivide luteus, fibrillosus; contextus margine luteus et in centro aurantiacus. Pileipellis monostrata, hyphis tenuibus pallide luteis non-gelatinosis. Basidiosporae asymmetricae, latae ovatae, 8.9–10.2  $\times$  6.5–7.4  $\mu\text{m}$ , in KOH cinnamomeae, nodulosis irregularibus tenuibus  $<$  0.5  $\mu\text{m}$  altis. — Typus: M. Danks, J.M. Trappe, T. Lebel & K. Vernes KV518 (holo MEL2331645 (holotypus hic designatus); iso NE94639), Australia, New South Wales, Mt Kaputar, Kaputar Rd, Plot GW2, 16 July 2007.

**Etymology.** Name refers to the mustard yellow colour of the veil (L.: sinapis = mustard; velus = veil).

**Sporocarps** hypogeous to emergent under leaf litter, in a small group. *Pileus* 6–15  $\times$  12–21 mm diam, convex to subglobose with a flattened apex, and slightly plicate margin attached to stipe by a thick cobweb yellow veil, which pulls away in patches to expose the hymenophore. *Pellis* pale tan brown, finely fibrillose, dry to moist when fresh but not viscid, not hygrophanous, not bruising, with overlying remnant yellow, fibrillose universal veil, easily rubbed off with handling. *Context* 0.5–3.0 mm thick, translucent yellow-tan. *Hymenophore* pale cinnamon brown initially, darkening slightly as spores mature, elongated labyrinthine to sublammellate, compressed, contorted/wrinkled and intervenose, especially near the apex and stipe, locules 0.5–2 mm diam. *Stipe-columella* percurrent, 18–35  $\times$  6–8 mm diam, bright yellow, fibrillose, in section with yellow edges and bright orange centre, central to slightly asymmetric, solid, slender, equal or slightly contorted, dry; *universal veil* remnants apparent as scattered slightly darker yellow-orange fibrils on pileus surface and stipe; *partial veil* a thick mustard yellow cortina between pileus margin and stipe. *Basal mycelium* bright yellow. **Odour** mild, not distinctive; **taste** not distinctive.

**Spores** 8.9–10.2  $\times$  6.5–7.4  $\mu\text{m}$ , mean (13 spores) = 9.4  $\times$  7.0  $\mu\text{m}$ , Q = 1.2–1.4, mean Q = 1.40, cinnamon brown (KOH), broadly ovoid, slightly asymmetric, ornamented with nodules, irregular, flat topped or rounded,  $<$  0.5  $\mu\text{m}$  tall; hilar appendage to 1  $\mu\text{m}$ , conspicuous, tapering, truncate; spores inamyloid non-dextrinoid; apex ornamented. *Basidia* 26–29  $\times$  7–8  $\mu\text{m}$ , hyaline, clavate to cylindrical, thin-walled, with 4 sterigmata. *Cystidia* (13.5–)16.5–26.5  $\times$  (5.5–)8–12.5(–17)  $\mu\text{m}$ , hyaline, clavate, thin-walled, abundant, never protruding beyond hymenium. *Hymenophoral trama* 15–30  $\mu\text{m}$  wide, of interwoven hyaline hyphae



**Fig. 18** *Cortinarius sinapivelus*. a. Pileipellis; b. spores. — Scale bars: a = 100  $\mu\text{m}$ ; b = 5  $\mu\text{m}$ .

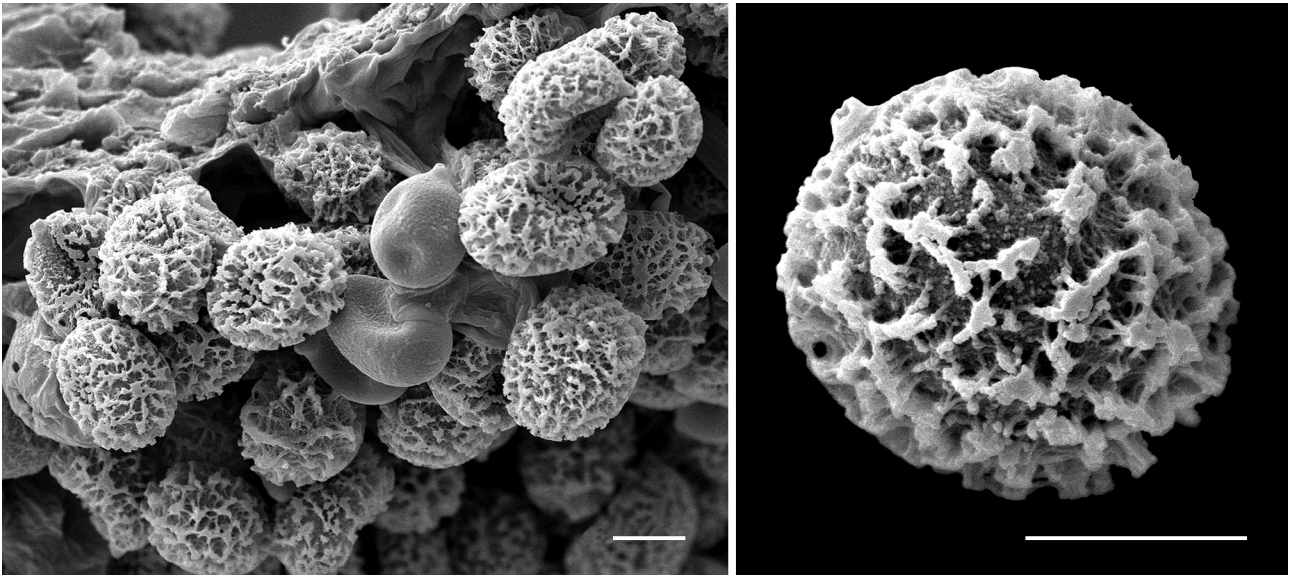


Fig. 19 Scanning electron micrographs of *Cortinarius sinapivelus* spores. — Scale bars = 10  $\mu\text{m}$ .

2.5–4  $\mu\text{m}$  diam and irregularly inflated elements 7.5–14  $\mu\text{m}$  diam; *subhymenium* undifferentiated from trama. *Pileipellis* simplex. *Veil* a patchy outer thin layer, 12–17  $\mu\text{m}$  wide, of hyaline subgelatinised hyphae 2.5–3  $\mu\text{m}$  diam; *epicutis* narrow, 26–55  $\mu\text{m}$  wide, of pale brown pigmented inflated  $\pm$  isodiametric cells 10–22  $\times$  8–19  $\mu\text{m}$ , merging with the *context*, 570–1250  $\mu\text{m}$  wide, of subparallel, irregularly inflated, hyaline hyphae, mostly 7.5–12.5  $\mu\text{m}$  diam, with scattered elements 25–30  $\mu\text{m}$  diam. *Clamp connections* present in the pileus.

**Habitat & Distribution** — In New South Wales, occurring in sub-alpine grassy woodland on the Kaputar Plateau among *Eucalyptus dalrympleana* and *E. pauciflora*. Fruiting: July.

*Specimens examined*. Known only from type.

**Notes** — Although our preference is to not describe taxa from single collections, there were multiple sporocarps, all with varying degrees of elongate labyrinthine to sublammellate hymenophore, and a thick partial veil that remained attached to the stipe and pileus margin, even in mature sporocarps. *Cortinarius sinapivelus* may be distinguished from other Australian *Cortinarius* species with a yellow cortina by the distinctly sublammellate hymenophore, broadly ovoid spores, and pileus context of inflated  $\pm$  isodiametric cells. The sequestrate taxon *C. flavovellus* also has a brownish pileus and yellow veil, similarly structured pileus and robustly ornamented spores. However, *C. flavovellus* has a cinnamon brown rather than pale tan brown pileus, a distinctly loculate rather than sublammellate hymenophore, and larger spores 13–15  $\times$  6.5–8.5  $\mu\text{m}$  vs 8.9–10.2  $\times$  6.5–7.4  $\mu\text{m}$ . The bright pigments of the universal and partial veils, stipe, and basal mycelium are consistent with close affinities with section *Dermocybe* or *Splendidi* for both *C. flavovellus* and *C. sinapivelus*.

Analyses of ITS sequences confirms placement of *C. sinapivelus* in a well supported section *Splendidi* (bootstrap 76 %), close to a New Zealand sequence of *C. persplendidus* in a subclade (bootstrap 52 %) with the Australian species *C. basirubescens* and *C. erythrocephalus* (Fig. 1). *Cortinarius basirubescens*, *C. erythrocephalus* and *C. persplendidus* have rich red or red and yellow sporocarps with bright yellow basal mycelium. Another Australian red-pigmented species, *Dermocybe kula*, is also in this broader *Splendidi* clade, though it has been shown to have unique red pigments. *Cortinarius sinapivelus* lacks bright red pigments, having a brown pileus, however does resemble *C. persplendidus* in the bright yellow stipe, bright yellow cortina, and bright basal mycelium. *Cortinarius clelandii*, which is in a well

supported (bootstrap 94 %) subclade with the sequestrate taxa *C. globuliformis* and *C. sejunctus*, has duller sporocarps and the spore ornamentation is less robust and more citriniform than *C. sinapivelus* (Jones 2007).

## DISCUSSION

Several clades representing sections within *Cortinarius* sensu Peintner et al. (2002a) and Garnica et al. (2005) were recovered in our analyses of ITS sequences, with varying support (Fig. 1). Not all subgenera were included, such as solely northern hemisphere section *Calochroi* (Garnica et al. 2009) in final analyses. Poor bootstrap support for the deeper branches is typical for such a large dataset, based upon a single region. Inclusion of nLSU data could perhaps help to clarify some of these deeper relationships, however in this paper we were more concerned in placing our new taxa in a general sectional framework.

As has been shown by several workers, the separation of a large and diverse genus *Cortinarius* from *Hebeloma* and *Gymnopilus* is strongly supported (Peintner et al. 2002a, 2004, Garnica et al. 2005, Francis 2007). Sequestrate sporocarp forms are scattered throughout many different lineages within *Cortinarius*, *Descolea* and *Hebeloma*, thus sequestrate cortinarioid genera (based on historical morphological characters) are not monophyletic. The sequestrate genus *Hymenogaster* is again shown to be paraphyletic, with *Hymenogaster A* (including specimen from Spain of *H. buillardii*) having affinities to *Hebeloma* (73 % bootstrap, Fig. 1) and *Hymenogaster B* (bootstrap 85 %), along with two species of *Protoglossum*, within *Cortinarius*. The related sequestrate genera *Descomyces* and *Timgrovea*, with affinities to *Descolea*, are diverse in Australia, with some 35 undescribed species (Francis 2007, Trappe pers. comm.). Further investigation of the affinities of *Hymenogaster* should include type studies as well as greater incorporation of these southern taxa.

Broader geographic patterns, of subclades of southern hemisphere taxa within larger sectional clades are apparent (Fig. 2). However this is partly due to taxon selection, with an emphasis on southern hemisphere taxa for the present analyses. Host tree association has been considered a driving force in the evolution of the genus *Cortinarius* (Horak 1973, Garnica et al. 2009). In Australia species in the genera *Nothofagus* and *Eucalyptus* are the main tree associates of native ectomycorrhizal fungi. Although we currently lack extensive geographic data for most

cortinarioid species, the broader pattern for Australian ectomy-corrhizal fungi appears to be a lack of host tree species fidelity, i.e. 'any eucalypt will do' (May 2002). In several clades in our analyses, *Pseudotriumphantes*, *Rozites* 'A', a mixture of closely related taxa with associations with *Nothofagus* and *Eucalyptus* occur (Fig. 2). A host-shift from *Nothofagus* to *Eucalyptus* has occurred at least once in the Western Australian species *C. symea* (Bougher et al. 1994). However, at this early stage in species delimitation it is not possible to evaluate radiation of taxa or centres of origin for particular sections within *Cortinarius* in Australia.

The loss of gross morphological characters in sequestrate sporocarp forms can make placement of taxa within broader sectional groupings difficult. The use of molecular data as additional characters, has helped considerably in this goal. However, for most of the novel species presented here, morphological characters were also found to support their placement with agaric taxa in the same clades. Although no totally sequestrate fungi clades occur in our analyses, the great diversification of the sequestrate form in Australia in many agaric families, means that some of these groupings may become apparent in future analyses. The appearance of sequences from a single 'species' in several different lineages, (i.e. *C. campbellae*), highlights the need for type studies and clarification of cryptic taxa within Australian sequestrate *Cortinarius* species, particularly section *Purpurascetes*.

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