

New *Cortinarius* (Agaricales) species described from New Zealand

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ABSTRACT

As part of an ongoing effort to investigate the diversity of the genus *Cortinarius* in New Zealand, twelve new species are described: *C. caryotoides*, *C. citribasalis*, *C. durifoliorum*, *C. eucollybianus*, *C. eunomalus*, *C. juglandaceus*, *C. lanceolatus*, *C. minilacus*, *C. peraurilis*, *C. pseliocaulis*, *C. rubrimarginatus*, and *C. salmastrium*. Moreover, the diversity of *Cortinarius* section *Limonii* and subgenus *Callistei* are reviewed in the light of recent findings in the South Pacific, and a key is provided. It is shown that both infrageneric taxa are bihemispherical, while the core population of the former is actually located in New Zealand. A phylogram, covering the taxa discussed, is presented in order to illustrate their genetic relations.

KEYWORDS Agaricales; *Cortinarius*; mycorrhiza; Myrtaceae; Nothofagaceae; taxonomy, New Zealand.

Introduction

Fungi of the genus *Cortinarius* (Pers.) Gray are abundant and diversified in New Zealand, where many species exhibit vivid red, yellow, and orange hues, forming a decorative element on the native forest floor. These species form ectomycorrhiza with plants of the Myrtaceae and Nothofagaceae families. Their sizes vary from small to fairly large, and their fruitbodies are dry or viscid. Recent molecular investigations (Garnica et al. 2016; Soop et al. in prep.) reveal that these brightly coloured species occur primarily in three genetic groups, which can be characterised as "dermocyboid", "leprocyboid", and "telamonioid", with reference to the names of traditional *Cortinarius* subgenera.

Members of the dermocyboid group often resemble species in subgenus *Dermocybe* (Fr.) Trog, which means that they are mostly of a modest size and react strongly red with alkaline solutions on parts of their basidiome, thus indicating the presence of anthraquinonic metabolites. The leprocyboid group consists of small to fairly large fungi with a weaker alkaline reaction, which resemble species in subgen. *Leprocycbe* M.M. Moser as well as in *Dermocybe*. The telamonioid group contains dermocyboid taxa that lack an alkaline reaction. Genetically the three groups appear to be closely related (Garnica et al. 2016 Figure S2), suggesting a common evolutionary origin. They may be attributed mainly to *Dermocybe* sect. *Icterinula* E. Horak & M.M. Moser, *D.* sect. *Papuerae* M.M. Moser & E. Horak, *Cortinarius* sect. *Limonii* Kühner & Romagn. ex Nezdobjm., *C.* subgen. *Callistei* Liimat., Niskanen & Ammirati, and an unpublished section around *C. persplendidus* Gasparini (Stefani et al. 2013; Soop et al. in prep.).

Many species in these groups were described by Horak (1987) and Soop (1998–2016). One aim of this eighth instalment in a series on *Cortinarius* taxa from New Zealand is to further investigate the affinities within the groups; this concerns the first five species described. Other species treated in the present study may be placed in sect. *Anomali* Konrad & Maubl., and subgen. *Telamonia* (Fr.) Trog, as morphologically defined by Brandrud et al. (1989). Species in these infrageneric taxa were partly considered in the previous instalments (loc. cit.), but have not been otherwise treated in publications aimed at the mycota of the country.

Materials and methods

Studied taxa

All collections under *Typification* and *Other collections examined* were made in the native forests of New Zealand under the appropriate permits issued by the Department of Conservation.

Species mentioned for comparison under *Comments* are described from New Zealand unless otherwise specified. All holotype material has been deposited in the PDD fungarium, Auckland, New Zealand. The GenBank accession numbers and fungarium numbers are given under *Typification* and *Other collections examined*. Collection localities are referred to the districts defined by Crosby et al. (1998).

Phylogenetic reconstruction

DNA was extracted with the DNeasy Plant Mini Kit (QIAGEN, Redwood City, California) or the Nucleospin Plant II Mini Kit (Macherey-Nagel, Düren, Germany) following the manufacturer's protocols. The nuclear ribosomal internal transcribed spacer (ITS1–5.8S–ITS2) and 28S large subunit (LSU) were amplified with the primer pairs ITS1/ITS4 (White et al. 1990), and LR0R/LR5 (Vilgalys & Hester 1990), respectively. PCR and sequencing protocols followed Soop et al. (2016). Contigs were evaluated by BLAST against the NCBI nucleotide database (Altschul et al. 1990) and UNITE (Kõljalg et al. 2013). Additional ITS sequences with significant similarity were retrieved from GenBank (<http://www.ncbi.nlm.nih.gov/nucleotide>) and included in the phylogenetic analysis (Fig. 5).

When separated, ITS and LSU sequences were manually concatenated, whereas in a few cases only ITS was available. The data set was then aligned with MAFFT v. 7 (<http://mafft.cbrc.jp/alignment/server/>), using the E-INS-i option. The alignment was manually corrected in Mega 5.2.1 (Tamura et al. 2011). The resulting alignment was 1721 positions long. Phylogenetic analysis was performed with RAxML (Stamatakis 2014) using the raxmlGUI (Silvestro & Mihalak 2012). 1000 ML rapid bootstrap searches and the GTRGAMMA substitution model were applied. The resulting phylogenetic tree was edited in Mega 5.2.1 (Tamura et al. 2011).

Morphology

In the descriptions, measurements of the basidiome pertain to adult specimens; these are diameter of the pileus, length of the stipe, and diameter of the upper part of the stipe. Lamella colour pertains to immature individuals unless specified otherwise, the designation "L=" means the number of lamellae reaching the stipe, and "l=" the number of lamellulae between two lamellae. The universal and partial veils of the basidiome are referred to as "veil" and "cortina", respectively. The alkaline reaction was made with a 30% NaOH solution unless otherwise specified.

Microscopic observations were made principally on material mounted in 5% ammoniacal solution, with or without Congo red, and examined with an oil-immersion objective (1000 ×). The term "marginal elements" refers to sterile cells that are found on the lamellar edge. The spore measurements are expressed as the mean value with one-sigma limits and, in parentheses, the observed maxima and minima. The *Q* value is the length/width quotient; its average and standard deviation are reported. The *n* value is the number of measurements.

Taxonomic treatment

Cortinarius peraurilis Soop & Dima, sp. nov.

(Figures 2B, 4B)

MycoBank 822875.

Typification. New Zealand. Otago Lakes, Milford Rd, Totara Rest Area, in *Fuscospora cliffortioides* forest, 22 April 2004, K. Soop CO1405, holotype PDD 107505, GenBank MF568044 (ITS), MF568049 (LSU).

Etymology. From its resemblance to *C. per aureus* and Latin *-ilis* 'similar to'.

Pileus 8–25 mm diam., obtusely conical, later campanulate, dry, hygrophanous, saturated brownish orange with a darker umbo, finely innate fibrillose, margin striate. *Lamellae* pale ochraceous yellow to dark yellow when young, adnate, distant (L=36, l=1), edge concolorous. *Stipe* 20–55 × 2–3 mm, cylindrical, greyish yellow to pale brown, with ± distinct pale yellow bands. *Veil* pale yellow to white, rather sparse; *cortina* very fugacious. *Context* yellow-brown. *Odour* rather strong, raphanoid to phlegmacioid; *taste* insignificant. *Macrochemical reactions*: NaOH dark red to black on cutis, nil on stipital veil.

Spores (7.1–)7.5–8.2–8.9(–9.3) × (4.6–)4.6–4.9–5.2(–5.5) μm, Q=1.68±0.16 (n=23), ellipsoid, weakly verrucose. *Marginal elements* 17–35 × 8–10 μm, prominent, crowded, clavate or irregular. *Basidia* 22–28 × 7–9 μm, 4-spored. *Pileipellis* of repent hyphae 3–6 μm wide. *Hypocutis* of rectangular, somewhat irregular elements, 20–30 × 10–15 μm. *Clamp connections* present.

Habitat. Gregarious in Nothofagaceae forest, rare.

Other collections examined. New Zealand. Fiordland, Kepler Track, 29 April 2013, K. Soop CO2087, PDD 103660.

Comments. A very small, dark orange fungus in Nothofagaceae forests. The lamellar edge is provided with conspicuous cheilocystidia. According to our molecular analysis (Figure 5), *Cortinarius peraurilis* clusters with several austral species in *Dermocybe* sect. *Icterinula*. In this group it resembles several species in the same habitat, such as *C. indotatus* (E. Horak) G. Garnier and *C. sciurellus* Soop, but these display a stronger alkaline reaction and possess a different micromorphology. *C. peraurilis* also evokes *C. luteinus* Soop, but the latter does not react with alkaline solutions and is not closely related in our phylogenetic analyses.

Cortinarius* sect. *Limonii Kühner & Romagn, ex Nezdobjm.

Type: *C. limonius* (Fr.: Fr.) Fr.

In the phylogram (Figure 5) the section type is the only European member, and only two other species from the Northern Hemisphere are known in the section. In fact, *Limonii* has its core population in New Zealand with at least nine species, and no member has so far been reported from Australia or South America (Table 1).

<i>C. araniiti</i> Soop	New Zealand
<i>C. armiae</i> Soop	New Zealand
<i>C. aurantiobrunneus</i> Ammirati, Halling & Garnica	Central America
<i>C. caryotis</i> Soop	New Zealand
<i>C. caryotoides</i> n. sp.	New Zealand
<i>C. kroegeri</i> Niskanen, Liimat., E. Harrower, Berbee, Garnica & Ammirati	Europe
<i>C. limonius</i> (Fr.: Fr.) Fr.	Europe, North America
<i>C. rubrimarginatus</i> n. sp.	New Zealand
<i>C. rubrocastaneus</i> (Soop) A.M. Oliver & Orlovich	New Zealand
<i>C. viscilaetus</i> Soop	New Zealand

Table 1. Known taxa in section *Limonii* (with area of provenance).

Basidiomata are small to medium sized, and present vivid red-brown, orange, and yellow colours. They react with alkaline solutions, while the fluorescence in UV light is generally weak or absent. Spores are usually subglobose, medium verrucose. Two species, *C. rubrocastaneus* and *C. rubrimarginatus*, possess remarkable chrysobasidia, a rare feature in *Cortinarius* (the former taxon was for this reason originally placed in the genus *Gymnopilus*).

Key to sect. *Limonii*:

- 1 Pileus brightly orange-yellow, in *Picea* forest, Europe, North America *C. limonius*
1* Pileus mostly with a dominant reddish or dark brown component, with other hosts and in other regions 2
2 With *Quercus*, Central America (Costa Rica) *C. aurantiobrunneus*
2* In Nothofagaceae or Myrtaceae forest, New Zealand 3
3 Pileus brightly red to orange-red 4
3* Pileus darker mahogany red 8
3** Pileus yellow-brown to umber or blackish brown 6
4 Lamellae bright orange when young, basidiomata small, stipe <7 mm wide *C. araniiti*
4* Lamellae dull yellowish when young, basidiomata larger 5
5 Alkaline reaction strongly red on most parts, stipe \pm tapering *C. armiae*
5* Alkaline reaction trivial, stipe cylindrical, cf. *C. collybianus* (subgen. *Callistei*)
6(3) Spores subglobose, <9 μ m diam. 7
6* Spores amygdaloid to ellipsoid, longer *C. caryotoides*
7 Pileus dry, umber to blackish brown, mostly >35 mm diam. *C. caryotis*
7* Pileus viscid, yellow-brown, smaller *C. viscilaetus*
- 8(3) Lamellae yellowish to reddish when young, pileus <50 mm diam. 9
8* Lamellae whitish when young, pileus often larger, cf. *C. rubrodactylus* (subgen. *Callistei*)
9 Chrysobasidia present 10
9* Basidia trivial *C. sp.* (PDD 103635)
10 Lamellae mustard yellow *C. rubrocastaneus*
10* Lamellae brick red to dark red *C. rubrimarginatus*

***Cortinarius caryotoides* Soop & J.A. Cooper, sp. nov.**

(Figures 1A, 3A)

MycoBank 822876.

Typification. New Zealand. Buller, Lewis Pass, Boyle River Track, in *Leptospermum scoparium* forest, 12 May 2006, K. Soop CO1694, holotype PDD 103642, GenBank KF727389 (ITS), KF727309 (LSU).

Etymology. From its resemblance to *Cortinarius caryotis*.

Pileus 15–30 mm diam., obtusely rounded, later convex, viscid to almost dry, not hygrophanous, evenly dark brown, glabrous; margin concolorous without visible veil remnants, not striate. *Lamellae* pale yellow-brown when young, fairly distant ($L=34$, $l=1-2$), adnate, edge concolorous. *Stipe* 35–60 \times 3–6 mm, cylindrical or somewhat tapering downward, weakly viscid, yellowish white, flushing brown from base, apex almost white. *Veil* yellow-brown, fairly sparse; *cortina* yellow-grey. *Context* yellow-brown, darker in stipe centre. *Odour* and *taste* insignificant. *Macrochemical reactions:* NaOH red on stipital veil, red-brown on context and lamellae, black on cutis.

Spores (7.6–)8.1–8.8–9.4(–10.4) \times (5.1–)5.4–5.8–6.1(–6.5) μ m, $Q=1.53\pm 0.13$ ($n=30$), elliptic to \pm amygdaloid, moderately verrucose. *Marginal elements* scattered, clavate to cylindrical, 20–32 \times 6–8 μ m. *Basidia* 25–35 \times 7–8 μ m, 4-spored. *Pileipellis* with a thin gelified layer, lower hyphae repent 6–8 μ m wide, mostly strongly yellow-brown with epimembranal incrustations. *Hypocutis* of oblong, hyaline or pale yellow elements, 40–55 \times 10–15 μ m, lower strata with more irregular elements. *Clamp connections* present.

Habitat. Gregarious in Myrtaceae and Nothofagaceae forest, rare.

Other collections examined. New Zealand. Nelson, 15 May 2014, J. Cooper JAC13530, PDD 105781.

Comments. This is a small, viscid cortinar with yellow-brown colours, belonging to section *Limonii* (Figure 5). *Cortinarius caryotoides* evokes *C. viscilaetus* and *C. caryotis* in the same section, which, however,

produce subglobose spores. The rather similar *C. vernicifer* Soop and *C. verniciorum* Soop also have shorter spores, but are not closely related in our phylogenetic analysis.

Cortinarius rubrimarginatus Soop, sp. nov.

(Figures 2D, 4D)

MycoBank 822878.

Typification. New Zealand. Nelson, Floral Saddle, in *Fuscospora fusca* forest, 10 May 2004, K. Soop CO1467, holotype PDD 107502, GenBank MF568042 (ITS), MF568048 (LSU).

Etymology. From Latin *ruber* ‘red’ and *marginatus*, referring to the lamellar edge.

Pileus 13–20 mm diam., expanded to slightly conical, dry, hygrophanous, dark red-brown, rather coarsely innate fibrillose, margin with reddish tufts. *Lamellae* saturated brownish red to testaceous when young, edge conspicuously deep red, rather distant. *Stipe* 20–30 × 2 mm, cylindrical, yellow-brown with brownish red bands toward base. *Veil* distinctly brown-red, fairly copious; *cortina* not noted. *Context* brown. *Odour* and *taste* insignificant. *Macrochemical reactions:* NaOH black or trivial; fluorescence in UV light nil.

Spores (7.1–)7.3–7.6–8(–8.4) × (4.9–)5–5.2–5.5(–5.7) μm, Q=1.46±0.08 (n=31), obtusely ellipsoid, moderately verrucose. *Lamellar trama* orange-brown. *Marginal elements* and *basidia* mostly provided with orange-brown to yellow-brown lumps, especially in the head, sometimes incrustated. The former crowded, clavate, 20–35 × 8 μm; *basidia* 23–30 × 6–7 μm, 4-spored. *Pileipellis* of repent hyphae 3–5 μm wide. *Hypocutis* of elements with a pale yellow, cytoplasmatic pigment, oblong elliptic, 35–85 × 11–17 μm, those of deeper layers more rounded, 50–70 × 17–25 μm. *Clamp connections* present.

Habitat. Gregarious in Nothofagaceae forest, rare.

Comments. This is a small fungus with yellow-brown and reddish colours, where the red component is especially evident on veil remnants and on the lamellae, whose edge presents a saturated red hue.

Cortinarius rubrimarginatus belongs to section *Limonii* (Figure 5), where it shares the presence of conspicuous chrysocystidia with *C. rubrocastaneus*. It may be difficult to differentiate from *C. palissandrinus* Soop in the same habitat, which possesses a yellow veil and belongs genetically to a different group. The species is otherwise well defined by the mentioned characters, but due its apparent rarity has not been recorded again in New Zealand. It was nevertheless deemed worth publishing it in this study in view of its importance for the taxonomy of the genus.

Cortinarius* subgen. *Callistei Liimat., Niskanen & Ammirati

Type: *C. callisteus* (Fr.: Fr.) Fr.

Cortinarius callisteus was included in the original *Limonii* group (Kühner & Romagnesi 1953), and has often been considered to have affinity to the morphologically rather similar *C. limonius* in the literature (see Brandrud et al. 2014). On the other hand it has been apparent at least since Moser (1969) that the two species are not closely related, a fact which is borne out by subsequent molecular studies (e.g., Peintner et al. 2004, and cf. Figure 5). The subgenus is bihemispherical with at least four species in New Zealand, one of which is undescribed (PDD 72676). See Niskanen et al. (2016), where the northern species were studied in detail. Two New Zealand species are keyed out in the *Limonii* key (above). See Table 2 for a species list.

<i>C. austrolimonius</i> M.M. Moser & E. Horak	South America
<i>C. callisteus</i> (Fr.: Fr.) Fr.	Europe, North America
<i>C. collybianus</i> Soop	New Zealand
<i>C. controversus</i> Gasparini	Australia
<i>C. eucollybianus</i> n. sp.	New Zealand
<i>C. infucatus</i> Fr. (<i>citrinofulvescens</i> M.M. Moser)	Europe
<i>C. neocallisteus</i> Kranab., Ammirati, Liimat. & Niskanen	North America, Europe
<i>C. rubrodactylus</i> Soop	New Zealand
<i>C. tofaceus</i> (Fr.) Fr.	Europe

Table 2. Known taxa in subgenus *Callistei* (with area of provenance).

Cortinarius eucollybianus Soop, sp. nov.

(Figures 1D, 3D)

MycoBank 822881.

Typification. New Zealand. Fiordland, Kepler Track, in *Fuscospora cliffortioides* forest, 6 May 2001, K. Soop CO1230, holotype PDD 107518, GenBank MF568046 (ITS), MF568051 (LSU).

Etymology. From Greek εὖ- 'truly', the taxon being the author's original conception of *Cortinarius collybianus*.

Pileus 20–50 mm diam., obtusely rounded, later expanded to campanulate, dry, hygrophanous, warmly red to dark orange-red, glabrous, finely granulose from reddish veil, margin darker red. *Lamellae* pale yellow to greyish ochre when young, free, distant (L=30, l=2–3), edge concolorous. *Stipe* 40–60 × 5–6 mm, cylindrical, yellow to pale yellow, with dense, reddish fibrils. *Veil* orange-red to orange-brown, sparse; *cortina* pale yellow. *Context* pale yellow. *Odour* faint like wax candles; *taste* insignificant. *Macrochemical reactions:* NaOH trivial; fluorescence in UV light none.

Spores (5.7–)6–6.3–6.7(–7.1) × (4.9–)5.2–5.4–5.7(–6) μm, Q=1.16±0.07 (n=27), subglobose, finely punctuate. *Marginal elements* hyaline, crowded to disparate, clavate to vesiculose, some cylindrical, 16–28 × 6–8 μm. *Basidia* 17–20 × 7–8 μm, 4-spored. *Pileipellis* of repent, hyaline hyphae 5–8 μm wide. *Hypocutis* elements oblong ellipsoid, 55–70 × 10–18 μm. *Clamp connections* present.

Habitat. Gregarious in Nothofagaceae forest, uncommon.

Other collections examined. New Zealand. Gisborne, 8 May 2001, E. & A. Horak ZT9636, PDD 72718, GenBank KY606988 (ITS), KY606990 (LSU). Taupo, 13 May 2001, E. & A. Horak, PDD 72761, GenBank KY606987 (ITS), KY606989 (LSU).

Comments. This middle-sized fungus is beautifully orange-red with a yellow stipe, almost indistinguishable from its sister species *Cortinarius collybianus* in subgen. *Callistei* (Figure 5), including the micromorphology. The main, but subtle difference, lies in the cap colour, being more drab reddish brown or orange-brown with the latter, while *C. eucollybianus* presents a strikingly red tone, coupled with a corresponding veil colour. The same red tone is found with *C. armiae* Soop in section *Limonii* (loc. cit.), which differs by larger basidiomes with the stipe usually tapering toward the base.

Cortinarius citribasalis Soop, sp. nov.

(Figures 1B, 3B)

MycoBank 822882.

Typification. New Zealand. Dunedin, Waipori Falls, in *Lophozonia menziesii* forest, 30 April 2011, K. Soop CO2018, holotype PDD 101845, isotype S F189996, GenBank KJ635214 (ITS+LSU).

Etymology. From Latin *citreum* 'lemon' and *basis* 'base', due to the typical coloration of the stipital base.

Pileus 12–35 mm diam., dry, hygrophanous, obtusely conical, later expanded to plane, sometimes with a narrow umbo; orange-brown to yellow-brown, disk often darker orange, velvety to coarsely innate fibrillose; margin paler with yellow-brown to greyish yellow fringes, ± sulcate, weakly striate. *Lamellae* dark red-brown when young, rather distant (L=30, l=2), free, edge darker. *Stipe* 25–65 × 2–5 mm, cylindrical, with a yellow-green sheen, especially towards the base, girdled by yellow to citrinous bands and fibrils, later brown-grey to brown-yellow, mycelial felt white. *Veil* green-yellow, darkening to red-brown, sparse to rather copious; *cortina* pale yellow. *Context* pale yellow to grey-brown. *Odour* faintly raphanoid; *taste* insignificant. *Macrochemical reactions:* NaOH black to reddish-black on cutis and lamellae, else trivial, fluorescence nil to weakly yellow.

Spores (7.6–)7.9–8.5–9(–9.8) × (4.6–)4.7–4.9–5.2(–5.5) μm, Q=1.72±0.01 (n=27), ellipsoid to amygdaloid, moderately verrucose. *Marginal elements* hyaline, crowded, clavate, a few capitate, 13–25 × 5–6 μm. *Basidia* 25–30 × 7 μm, 4-spored; most basidia as well as some basidiols with refractive, ± blue-green

granules. *Pileipellis* of repent, hyaline hyphae 4–6 µm wide. *Hypocutis* elements oblong ellipsoid, 28–45 × 8–15 µm. *Clamp connections* present.

Habitat. Gregarious in Nothofagaceae forest, rare.

Other collections examined. New Zealand. Westland, Haast Pass, Cameron Track, 27 April 2004, K. Soop CO1434, PDD 107504 GenBank MF568043 (ITS), MF568047 (LSU). Dunedin, Waipori Falls, 30 April 2011, K. Soop CO2019, PDD 101846. Buller, Springs Junction, Klondyke Spur Track, 4 April 2015, K. Soop CO2171, PDD 107701, GenBank KT875204 (ITS+LSU).

Comments. A small telamonioid fungus with the interesting combination of citrinous veil and lamellae with a reddish tint. *Cortinarius citribasalis* is quite similar to *C. paraxanthus* Soop, an olive-brown species with more yellow-brown lamellae and slightly narrower spores. According to our molecular analysis (Figure 5), the two cortinars are closely related.

Cortinarius durifoliorum Soop & Dima, sp. nov.

(Figures 1C, 3C)

MycoBank 822883.

Typification. New Zealand. Westland, Haast Pass, Blue Pools, in *Fuscospora cliffortioides* forest, 22 April 2011, K. Soop CO1999, holotype PDD 101829, isotype S F189988, GenBank KJ635210 (ITS+LSU).

Etymology. By association with its similarity to *Cortinarius sclerophyllum*.

Pileus 15–50 mm diam., conical, later broadly conical to campanulate with a small umbo, dry, hygrophorous, fragile, saturated red-brown, innate fibrillose, margin with a pink to purple flush and brown-red fibrils, not striate but sulcate when older. *Lamellae* brownish with a distinct violet tinge when young, moderately crowded. *Stipe* 35–105 × 2–6 mm, cylindrical, tall, slender, ± tough, silvery grey with a pink tinge and wine-brown to violet, rather dense bands and fibrils. *Veil* purple-red to dark brownish red rather copious; *cortina* white. *Context* red-brown, young marbled violet. *Odour* and *taste* faintly raphanoid. *Macrochemical reactions:* NaOH trivial.

Spores (6.5–)7.0–7.6–8.2(–8.9) × (5.5–)6.2–6.7–7.1(–7.3) µm, Q=1.14±0.1 (n=27), subglobose, moderately to fairly coarsely verrucose. *Marginal elements* hyaline, crowded, clavate, 17–25 × 7–9 µm. *Basidia* 20–27 × 7–9 µm, 4-spored. *Pileipellis* of repent hyphae, hyaline or with a diluted greyish yellow cytoplasmatic pigment, 4–6 µm wide. *Hypocutis* elements oblong, rounded rectangular, 40–55 × 20–30 µm, with a yellow-brown vacuolar-zebrated pigment. *Clamp connections* present.

Habitat. Fasciculate to gregarious in Nothofagaceae forest, occasional.

Other collections examined. New Zealand. Fiordland, Kepler Track, 24 April 2006, K. Soop CO1619, PDD 88255. Buller, Rahu National Park, Klondyke Spur Track, 4 May 2015, K. Soop CO2170, PDD 107700, GenBank KT875205 (ITS+LSU).

Comments. A slender, often brittle cortinar with dark reddish fringes and bands on the stipe, not uncommon in southern-beech forests. Molecular data places *C. durifoliorum* in the bihemispherical section *Anomali* Konrad & Maubl. (Dima et al. 2016; Figure 5), where it is sister to the almost identical *C. sclerophyllum* Gasparini, a species known only from Tasmania. The latter differs mainly by more violet tints on pileus and lamellae.

Both are quite similar to *Cortinarius spilomeus* Fr., especially the variety *depauperatus* J. Lange, which displays the same red veil patterns and grows in *Picea* forests of the Northern hemisphere. The former is the type of sect. *Spilomei* (Bidaud, Moëne-Loec. & Reumaux) Consiglio, D. Antonini & M. Antonini, sister to *Anomali*. Moreover, in the southern-beech forests of New Zealand there are two species that can easily be confused with the present taxon: *C. rattinoides* Soop, also in section *Anomali*, and the genetically isolated *C. mysoides* Soop (Figure 5). They both display reddish velar tufts on the stipe, but the former differs by deep violet lamellae when young, whereas the lamellae of the second are deep brick red and its spores more elongated.

Cortinarius eunomalus Soop, sp. nov.

(Figures 1E, 3E)

MycoBank 822884.

Typification. New Zealand. Nelson, St Arnaud Lodge, in *Leptospermum scoparium* forest, 6 May 2008, K. Soop CO1788, holotype PDD 94040, isotype S F93239, GenBank JQ287690 (ITS).

Etymology. From Greek ευ- ‘truly’, and νομαλος ‘regular’, in opposition to the similar *Cortinarius anomalus* (‘irregular’).

Pileus 20–40 mm diam., obtusely conical, later convex to campanulate, dry, hygrophanous, white frosty, later pale grey-brown, innate fibrillose, margin paler with a silky white rim when young, not striate.

Lamellae pale violet when young, sometimes with a grey tinge, adnexed, medium distant (L=38–44, l=1–2), edge concolorous. *Stipe* 45–80 × 3–5 mm, cylindrical, tall, straight, white, with thin white fringes and zones. *Veil* white, sparse; *cortina* white. *Context* pale violet when young, soon grey to greyish yellow, brunnescent with age. *Odour* faintly raphanoid; *taste* ± bitter. *Macrochemical reactions:* NaOH trivial.

Spores (6.8–)7.4–8.1–8.8(–9.3) × (4.4–)4.6–5.0–5.3(–5.7) μm, Q=1.63±0.14 (n=33), ellipsoid to amygdaloid, moderately to fairly weakly verrucose. *Marginal elements* hyaline, crowded, cylindrical to clavate, 18–32 × 6–8 μm. *Basidia* 20–27 × 6–8 μm, 4-spored. *Pileipellis* of repent hyphae, hyaline, 3–6 μm wide. *Hypocutis* elements oblong, obtusely cylindrical, 20–40 × 8–11 μm. *Clamp connections* present.

Habitat. Gregarious in Myrtaceae forest, uncommon.

Other collections examined. New Zealand. Buller, Lewis Pass, Boyle River Track, 6 May 2015, K. Soop CO2176, PDD 107706, GenBank KT875201 (ITS+LSU).

Comments. This is a medium-sized, pale, silky, telamonioid species, encountered in Myrtaceae woods. Its habit and hue recall members of sect. *Anomali* (loc. cit.), such as *Cortinarius anomalus* Fr., and especially *C. albocyaneus* Fr., due to the pale veil. Molecular data place *C. eunomalus* close to sect. *Anomali*, but in a basal position (Figure 5). It also resembles *C. laquellus* Soop, which is viscid and generally smaller, as well as *C. rattinus* Soop, which presents darker colours; moreover, these both grow in Nothofagaceae forest.

Cortinarius pseliocaulis Soop & J.A. Cooper, sp. nov.

(Figures 2C, 4C)

MycoBank 822885.

Typification. New Zealand. Buller, Lewis Pass, Boyle River Track, in *Fuscospora cliffortioides* forest, 3 May 2015, K. Soop CO2166, holotype PDD 107696, isotype S F267759, GenBank KT875176 (ITS+LSU).

Etymology. From Greek ψελιον ‘bracelet’, and καυλος ‘stem’, due to its rozitoid habit as well as its similarity to *Cortinarius pselioticton*.

Pileus 30–45 mm diam., obtusely conical, later broadly conical to campanulate, viscid, hygrophanous, brightly yellow-brown with a paler disk, or totally greyish yellow, glabrous, margin finely striate. *Lamellae* pale cinnamon when young, adnexed, medium crowded (L=56, l=2–3), edge concolorous. *Stipe* 45–80 × 3–5 mm, clavate to cylindrical, often with a small piston-like bulb, viscid, stuffed to hollow, white, zoned white below collar. *Veil* white, sparse; *collar* membranous, white, viscid, positioned above mid-stipe. *Context* white with a pale brown middle string in stipe. *Odour* and *taste* insignificant. *Macrochemical reactions:* NaOH trivial.

Spores (8.9–)10.0–10.6–11.3(–11.7) × (5.5–)6.4–6.7–7.3(–7.6) μm, Q=1.55±0.13 (n=29), amygdaloid, moderately verrucose. *Marginal elements* crowded, many grainy or with hyaline lumps, clavate, 22–38 × 7–13 μm. *Basidia* 32–36 × 11–13 μm, 4-spored, some 2-spored. *Pileipellis* of repent hyphae, hyaline, 4–5.5 μm wide, no gelatinous layer noted. *Hypocutis* elements irregular oblong, 40–70 × 14–25 μm. *Clamp connections* present.

Habitat. Gregarious in Nothofagaceae forest, uncommon.

Other collections examined. New Zealand. Mid Canterbury, 15 June 2014, J.A. Cooper JAC13394, PDD 105646. Taupo, 17 May 2001, E. & A. Horak ZT9359, PDD 72808.

Comments. The presence of a membranous partial veil, and the large, amygdaloid spores, make this medium-sized agaric a member of a diverse austral group of *Rozites* habit, clustered around *Cortinarius achrous* E. Horak, Peintner, M.M. Moser & Vilgalys, a very pale (even white), common species in New Zealand. While *C. pseliocaulis* is more yellow tinted than the latter, it is brighter than the otherwise similar *C. pselioticton* Soop. The viscosity of the stipe (including the collar) could be an occasional trait. Molecular data confirms the close affinity within this group (Figure 5), where *C. pseliocaulis* forms a distinct clade, sister to the species mentioned.

Cortinarius salmastrium Soop, sp. nov.

(Figures 2E, 4E)

MycoBank 822886.

Typification. New Zealand. Nelson, St Arnaud, Black Hill Track, in *Kunzea ericoides* forest, 8 May 2015, K. Soop CO2183, holotype PDD 107713, isotype S F267759, GenBank KT875202 (ITS+LSU).

Etymology. From its similarity and affinity to *Cortinarius salmaster*.

Pileus 18–28 mm diam., broadly conical to campanulate, viscid, hygrophanous, dark olive brown, glabrous to finely innate fibrillose, margin ± paler, weakly striate. *Lamellae* grey to pale grey-brown when young, emarginate, medium crowded, edge concolorous. *Stipe* 35–45 × 2–4 mm, dry, cylindrical, silky pale green-grey to pale green-blue, bluish black on lower half with a white coating at the base. *Veil* yellowish white, very sparse; *cortina* not noted. *Context* green-grey, olive brown toward stipital base, blackish green in pileus. *Odour* faintly raphanoid; *taste* insignificant. *Macrochemical reactions:* NaOH trivial.

Spores (6.8–)7.0–7.4–7.8(–8.2) × (4.4–)4.7–4.9–5.2(–5.5) μm, Q=1.50±0.10 (n=29), elliptic, moderately verrucose. *Marginal elements* scattered, clavate, 15–24 × 6–8 μm. *Basidia* 20–27 × 5–7 μm, 4-spored. *Pileipellis* of repent hyphae, with a greyish cytoplasmatic to ± granular content, 4–6 μm wide, in the gelatinous layer hyaline, 2–4 μm wide. *Hypocutis* elements irregular, rounded rectangular, with a greyish content, 28–50 × 18–22 μm. *Clamp connections* present.

Habitat. Gregarious in Myrtaceae forest, uncommon.

Other collections examined. New Zealand. Bay of Plenty, 4 May 2001, E. & A. Horak ZT9619, PDD 72698, GenBank KY606986 (ITS), KY606991 (LSU).

Comments. A small, viscid fungus with dark turquoise and olivaceous colours, growing in myrtaceous forests. These characters recall *Cortinarius salmaster* Gasparini, described from Tasmania, an affinity which is corroborated by molecular data (Figure 5). The latter is attributed to subg. *Phlegmacium*, subsect. *Panchroi* M.M. Moser & E. Horak by its author. *C. salmastrium* also recalls several species in sect. *Purpurascetes* M.M. Moser, e.g., *C. rhipiduranus* Soop, which all stain violaceous on manipulation. Also *C. aerugineoconicus* E. Horak displays similar colours but produces amygdaloid spores. Both species are described from New Zealand, but grow with southern beech and are not closely related in our phylogenetic analysis.

Cortinarius juglandaceus Soop, sp. nov.

(Figures 1F, 3F)

MycoBank 822887.

Typification. New Zealand. North Canterbury, Arthurs Pass, in *Fuscospora cliffortioides* forest, 20 April 1999, K. Soop CO1028, holotype PDD 107510, GenBank MF568045 (ITS), MF568050 (LSU).

Etymology. From Latin *Juglans* 'walnut tree', due to the colour and texture of the pileus surface reminding of the wood.

Pileus 15–25 mm diam., rounded, later convex, viscid, weakly hygrophanous, date brown, glabrous, margin young slightly violet. *Lamellae* pale greyish violet when young, emarginate, rather distant ($L=30$, $l=1-2$), edge concolorous. *Stipe* 20–30 × 3–4 mm, cylindrical, often with a small round bulb, viscid, filled, rather tough, grey-brown, young with a violet tinge. *Veil* pale violet, very sparse; *cortina* very fugacious. *Context* pale violet in upper stipe, else pale tan to grey. *Odour* faint, somewhat sweetish; *taste* insignificant. *Macrochemical reactions*: NaOH trivial.

Spores (9.3–)10.0–10.8–11.5(–12.5) × (5.5–)5.7–6.3–6.8(–7.6) μm , $Q=1.72\pm 0.12$ ($n=31$), amygdaloid, coarsely and densely verrucose. *Marginal elements* numerous, clavate, 22–28 × 8–10 μm . *Basidia* 25–30 × 8–11 μm , many 1-spored, some 2-spored or 4-spored, often angular. *Pileipellis* with a thick, gelatinous layer of tangled hyphae, 2–3 μm wide; epicutis hyphae repent with a yellow-brown cytoplasmatic and sparsely incrustated pigment, 3–5 μm wide. *Hypocutis* elements irregular, rounded rectangular, with a yellow-brown content, 27–40 × 8–11 μm . *Clamp connections* sparse.

Habitat. Gregarious in Nothofagaceae forest, rare.

Comments. A small, viscid, brown fungus with blue lamellae and an exterior reminding of polished wood. It somewhat resembles a miniature *Cortinarius marmoratus* E. Horak, which is larger and genetically distant according to our molecular analysis (Figure 5). In our analysis, *C. juglandaceus* is genetically close to *C. cuphomorphus* Soop, another myxacioid species, which differs by a larger habit, paler colours, and a more copious veil. The species has not been recorded again in New Zealand, but it was deemed worth publishing it in this study in view of its importance for the taxonomy of the genus.

Cortinarius minilacus Soop, J.A. Cooper & Dima, sp. nov.

(Figures 2A, 4A)

Mycobank 822888.

Typification. New Zealand. Nelson, St Arnaud Campsite, in *Kunzea ericoides* forest, 4 May 2013, K. Soop CO2092, holotype PDD 103665, isotype S F244775, GenBank MF577079 (ITS+LSU).

Etymology. A direct translation of the Māori name *Rotoiti* (Latin *mini* 'small', *lacus* 'lake'), the lake in New Zealand near which the holotype was found.

Pileus 20–40 mm diam., dry, hygrophanous, date brown, finely innate fibrillose; margin ± paler with a pale ochre frost, striate. *Lamellae* yellow-brown when young, free, rather distant ($L=28-36$, $l=2-3$). *Stipe* 25–90 × 3–7 mm, cylindrical, pale brownish yellow with thin, ochraceous zones, apex concolorous, mycelial felt white. *Veil* pale ochraceous to almost white, sparse; *cortina* white. *Context* brown-yellow. *Odour* raphanoid; *taste* insignificant. *Macrochemical reactions*: NaOH trivial.

Spores (4.9–)5.2–5.6–6.1(–6.5) × (4.0–)4.3–4.7–5.1(–5.7) μm , $Q=1.20\pm 0.08$ ($n=30$), small, subglobose, pale, weakly verrucose. *Marginal elements* crowded, clavate to cylindrical, hyaline, 16–22 × 6–8 μm . *Basidia* 19–24 × 6–7 μm , 4-spored, often with yellow lumps. *Pileipellis* hyphae 4–6 μm wide, repent with a pale yellow-brown content. *Hypocutis* elements cylindrical to rectangular, pale, 45–80 × 9–17 μm . *Clamp connections* present.

Habitat. Gregarious in Myrtaceae forest, uncommon.

Other collections examined. New Zealand. North Canterbury, 8 June 2013, J.A. Cooper JAC12866, PDD 96970. Auckland, Albany, Northwood Reserve, 11 May 2011, K. Soop CO2042, PDD 101868, S F190008.

Comments. This is a telamonioid fungus with drab, yellow-brown colours, growing in myrtaceous forests. It is similar to several species found in the native forests of New Zealand, especially *Cortinarius xenosmatoides* Soop, which deviates by reddish lamellae, larger spores, and by growing in Nothofagaceae forest. In myrtaceous forests *C. minilacus* could be confused with *C. amblyonis* Soop, which deviates mainly by a more red-brown pileus. It is not closely related genetically to any known taxon, but forms, according to our molecular analysis (Figure 5), a small clade together with two undescribed taxa (PDD 107520, PDD 72798).

Cortinarius lanceolatus M. Wallace, sp. nov.

(Figures 2F, 4F)

MycoBank 822889.

Typification. New Zealand. Taupo, Kaimanawa Forest Park, Clements Mill Rd, in *Lophozonia menziesii* and *Fuscospora fusca* forest, 30 May 2015, M. Wallace DSC5545, holotype PDD 107496, GenBank MG019343 (ITS), MG019369 (LSU).

Etymology. From Latin *lancea* 'lance', for the macroscopic form of the basidiome, especially in young specimens.

Pileus 7–15 mm diam., lanceolate to hemispherical, later conical to campanulate with a broad but pointed umbo, slightly viscid, hygrophanous; reddish brown, darker reddish brown at disc, pale tan when dry; margin finely appendiculate from veil remnants when young, striate half way to disc; cutis covered in pale ochraceous decurved squamules arranged in concentric rings becoming punctuate-squamulose towards the margin. *Lamellae* pale yellow-brown when young, margin paler, adnate, sometimes with a decurrent tooth, distant, (L=10–13, l= 3), edge smooth to minutely fimbriate with age. *Stipe* 35–45 × 2–4 mm, attenuated upwards with an enlarged apex, flexuous, solid near the apex, fistulose towards the base; grey-brown, above cortina darker red-brown or concolorous with pileus and adorned with fine ochraceous punctuate scales and fibrils; below cortina covered by fine cottony, ochraceous fibrillose veil remnants. *Veil* yellowish to pale ochraceous, fibrillose on stipe, punctuate-squamulose on cap surface. *Cortina* membranous, yellowish to pale ochraceous, non-striate, persistent. *Context* dark red-brown at apex, becoming yellowish towards the stipe base, smell and taste sweet, farinaceous. *Chemical reactions* on pileus and stipe: KOH nil.

Spores (8.0–)8.6–8.6–9.0(–9.3) × (4.6–)5.0–5.0–5.3 μm, Q=1.75±0.05, amygdaliform, finely verrucose with some sparsely dispersed slightly coarser warts, plage absent. *Marginal elements* 17–21 × 8–12 μm, clavate to ampullaceous, incrustated with yellow-brown pigment. *Basidia* 22–28 × 8–9 μm, clavate, 4-spored. *Pileipellis* consisting of hyaline inflated clavate to fusiform elements, some terminal cells irregularly shaped, often rectangular and with irregular finger-like projections, cells furthest from terminal cells incrustated with yellow-brown pigment, 12–19 μm wide. *Hypocutis* consisting of thinner elongated hyphae heavily incrustated with yellow-brown pigment, 40 × 5 μm. *Veil hyphae* hyaline, cylindrical with aciculate to lanceolate terminal elements, cells furthest from terminal cells incrustated with yellow-brown pigment, 8–13 μm wide. Clamp connections present.

Habitat. Gregarious amongst leaf litter in Nothofagaceae forests. New Zealand.

Other collections examined. New Zealand. Taupo, Kaimanawa ranges, Clements Mill Rd, Te Iringa track, 2 June 2012, M. Wallace DSC1905; *idem* 1 June 2013, M. Wallace DSC1588; *idem* 31 May 2014, M. Wallace DSC3557.

Comments. A very small telamonioid fungus found in troops in leaf litter in the Nothofagaceae forests of New Zealand and possibly also of Australia. *Cortinarius lanceolatus* has many macro and micro characteristics reminiscent of smaller taxa in the genus *Descolea*. According to our molecular analysis (Figure 5), this species belongs to the bihemispherical section *Laeti* Melot, where many sister species present similar colours and velar characters.

Discussion

Several recent works (Garnica et al. 2016; Stefani et al. 2013) have revealed genetic kinships between *Cortinarius* taxa found in Australia and New Zealand. These affinities are often supported by morphological traits, and the fruitbodies sometimes look like “local variants” of one species. The taxa may be described as subspecies (or varieties) of one species, or, if their genetic and morphological differences are sufficient, as two distinct species, one from each country. We mention two such cases of species pairs in the present study, and others are found in various works (Table 3).

New Zealand species	Australian species	section/clade	reference
<i>C. durifoliorum</i> n. sp.	<i>C. sclerophyllum</i> Gasparini	<i>Anomali</i>	this study
<i>C. salmastrum</i> n. sp.	<i>C. salmaster</i> Gasparini	<i>Salmaster</i>	this study
<i>C. persplendidus</i> Gasparini	" <i>Dermocybe splendida</i> "	<i>Persplendidi</i>	Garnica et al. 2016
<i>C. ignotus</i> E. Horak	<i>C. sinapicolor</i> Cleland	<i>Sinapicolores</i>	Garnica et al. 2016
<i>C. artosus</i> Soop	<i>C. coelopus</i> Gasparini	<i>Elastici</i>	Soop 2014, Garnica al. 2016
<i>C. cretax</i> Soop	<i>C. lacteus</i> Gasparini	<i>Cretaces</i>	Soop et al., in prep
<i>C. dysodes</i> Soop	<i>C. tasmacamphoratus</i> Gasparini	<i>Camphorati</i>	Soop et al., in prep

Table 3. Examples of pairs of closely related *Cortinarius* species where one species occurs in New Zealand and the other in Australia.

In addition to species pairs, there are also cases where what is considered as the same species is widely distributed in the South Pacific region. Horak (1983) discusses a number of such taxa, and some of these biogeographical links have since been corroborated by molecular studies, even though taxa were sometimes identified by local synonyms. Table 4 gives examples of species that appear to be shared between Australia and New Zealand:

Species	Late synonym	section/clade	reference
<i>C. australis</i> Gasparini		<i>Purpurascentes</i>	Soop 2016
<i>C. austrovaginatus</i> Gasparini		<i>Austrovaginati</i>	Soop et al., in prep
<i>C. austrocyranites</i> Soop		<i>Austrocyranites</i>	Gasparini 2007
<i>C. canarius</i> (E. Horak) Gasparini			unpublished
<i>C. papaver</i> Soop	<i>C. austrocinnabarinus</i> R.H. Jones & T.W. May		Garnica et al. 2016
<i>C. rotundisporus</i> Cleland & Cheel		<i>Delibuti</i>	unpublished
<i>C. calaisopus</i> Soop		<i>Delibuti</i>	Soop 2010
<i>C. kioloensis</i> A.E. Wood		<i>Cortinarius</i>	Harrower et al. 2015
<i>C. persicanus</i> Soop			Gasparini 2007
<i>C. memoria-annae</i> Gasparini			Garnica et al. 2016
<i>C. naphthalinus</i> Soop	<i>C. fulvoiubatus</i> Gasparini		Garnica et al. 2016

Table 4. Examples of single *Cortinarius* species that occur in both New Zealand and Australia.

Such affinities are of course not surprising, given the well-established geological history of the region (Swenson et al. 2001), and are parallel to those observed between other land masses, such as Europe and North America (Garnica et al. 2011; Cripps et al. 2015). An example of the latter is found in subgen. *Callistei* (Figure 5), where the type possesses the American sister species *C. neocallisteus*.

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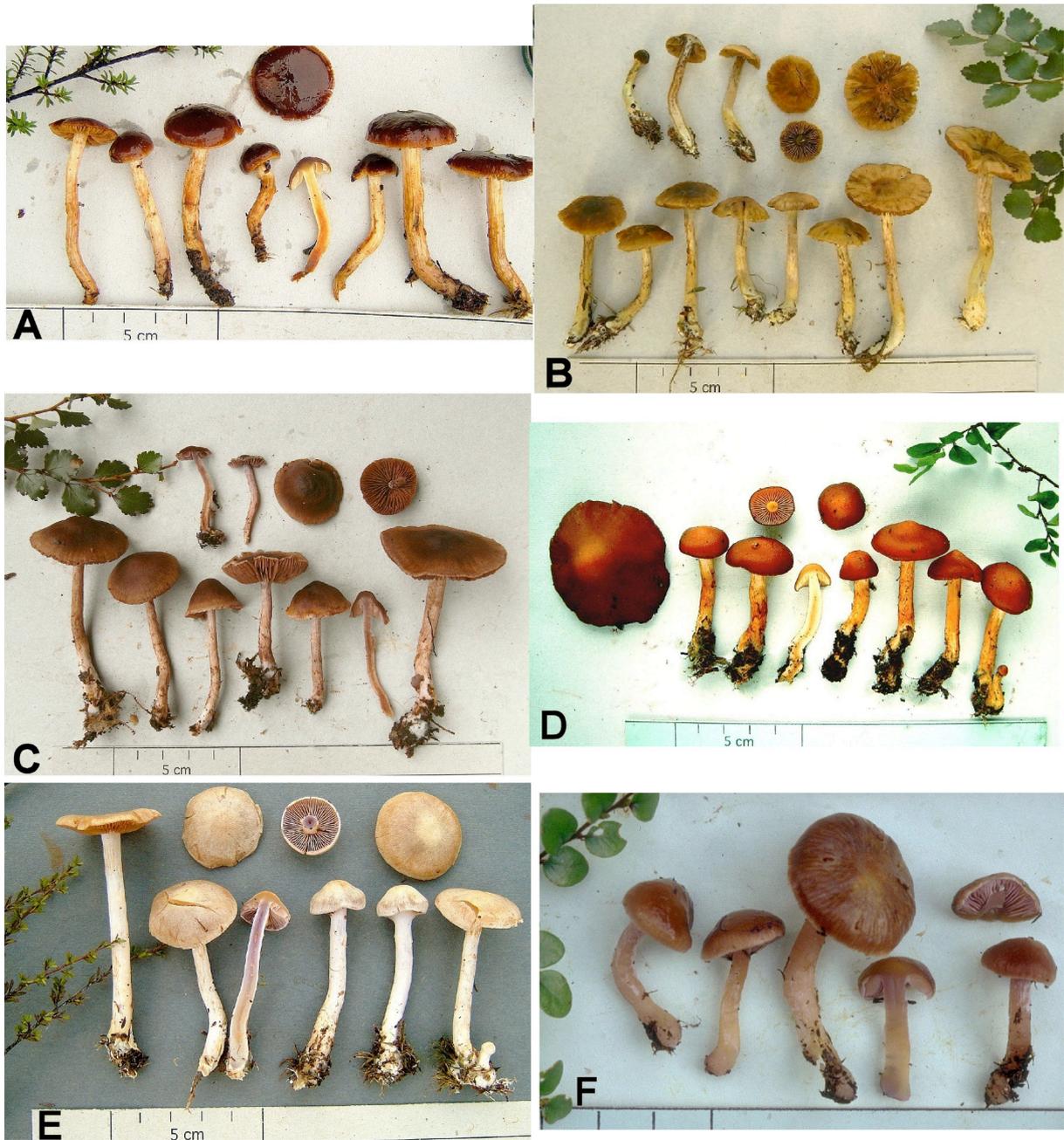


Figure 1 Basidiomata. **A**, *Cortinarius caryotoides*; **B**, *C. citribasalis*; **C**, *C. durifoliorum*; **D**, *C. eucollybianus*; **E**, *C. eunomalus*; **F**, *C. juglandaceus*.

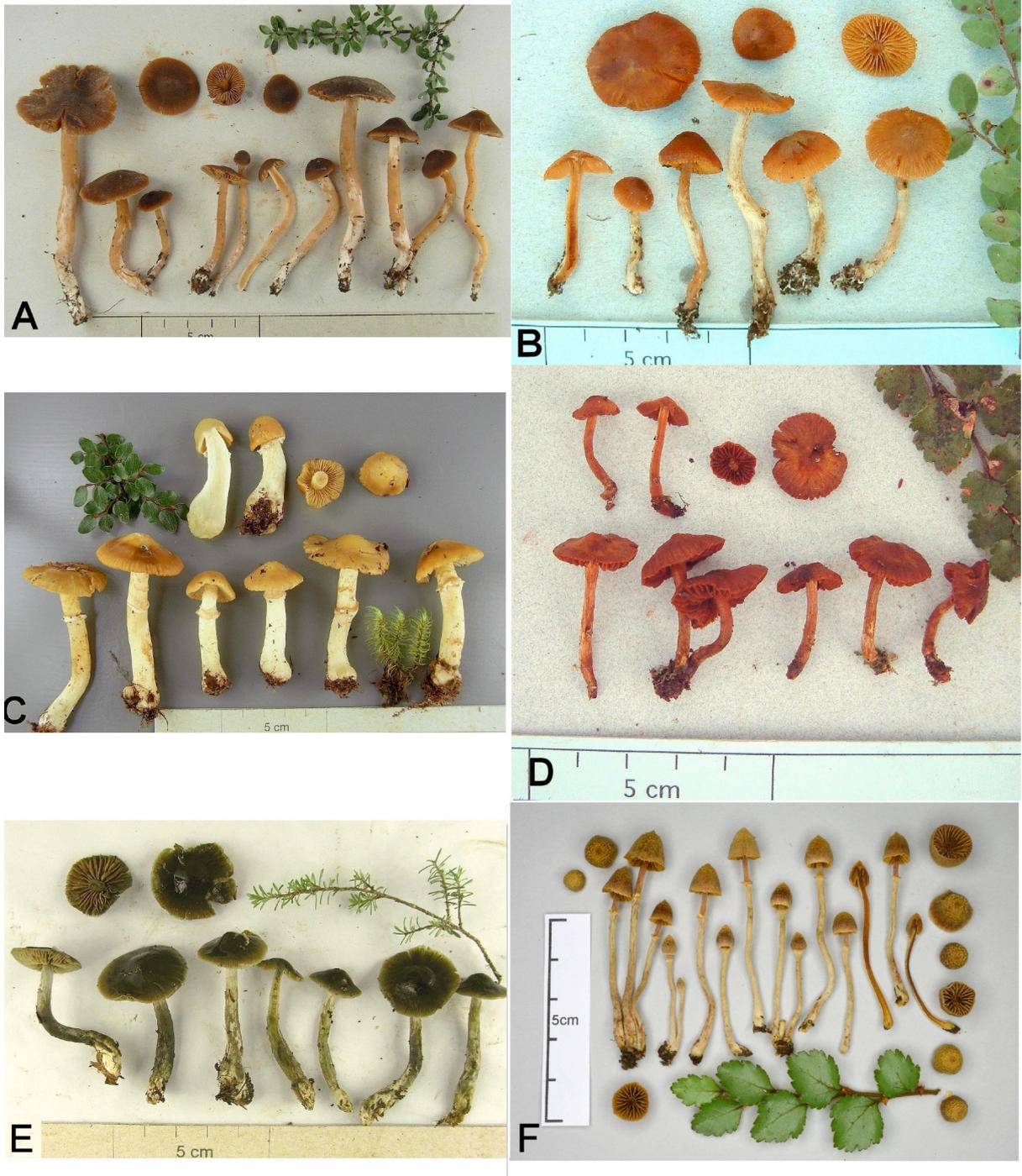


Figure 2 Basidiomata. **A**, *Cortinarius minilacus*; **B**, *C. peraurilis*; **C**, *C. pseliocaulis*; **D**, *C. rubrimarginatus*; **E**, *C. salmastrium*; **F**, *C. lanceolatus*.

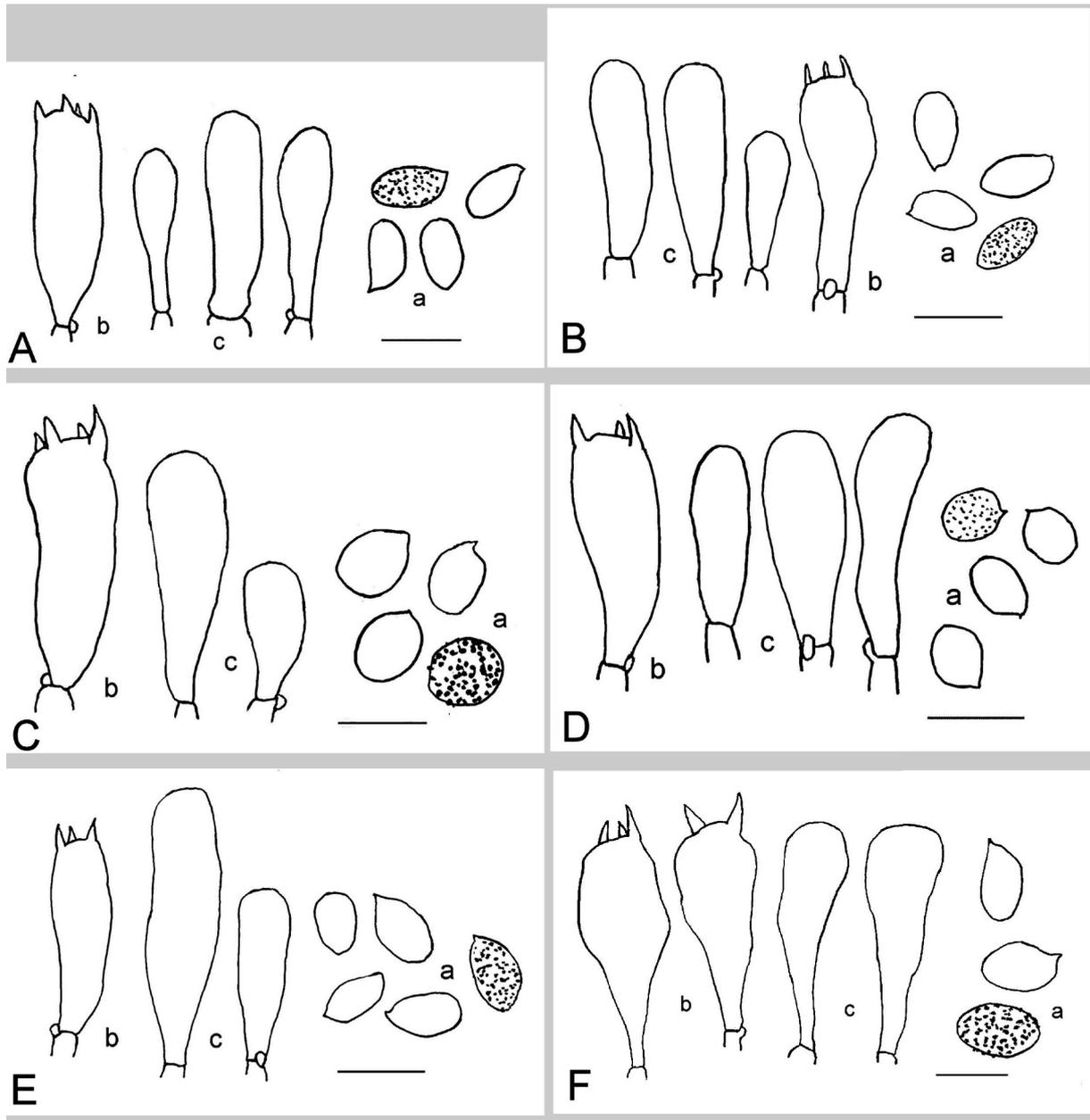


Figure 3 Microscopic details. **A**, *Cortinarius caryotoides*; **B**, *C. citribasalis*; **C**, *C. durifoliorum*; **D**, *C. eucollybianus*; **E**, *C. eunomalus*; **F**, *C. juglandaceus*.

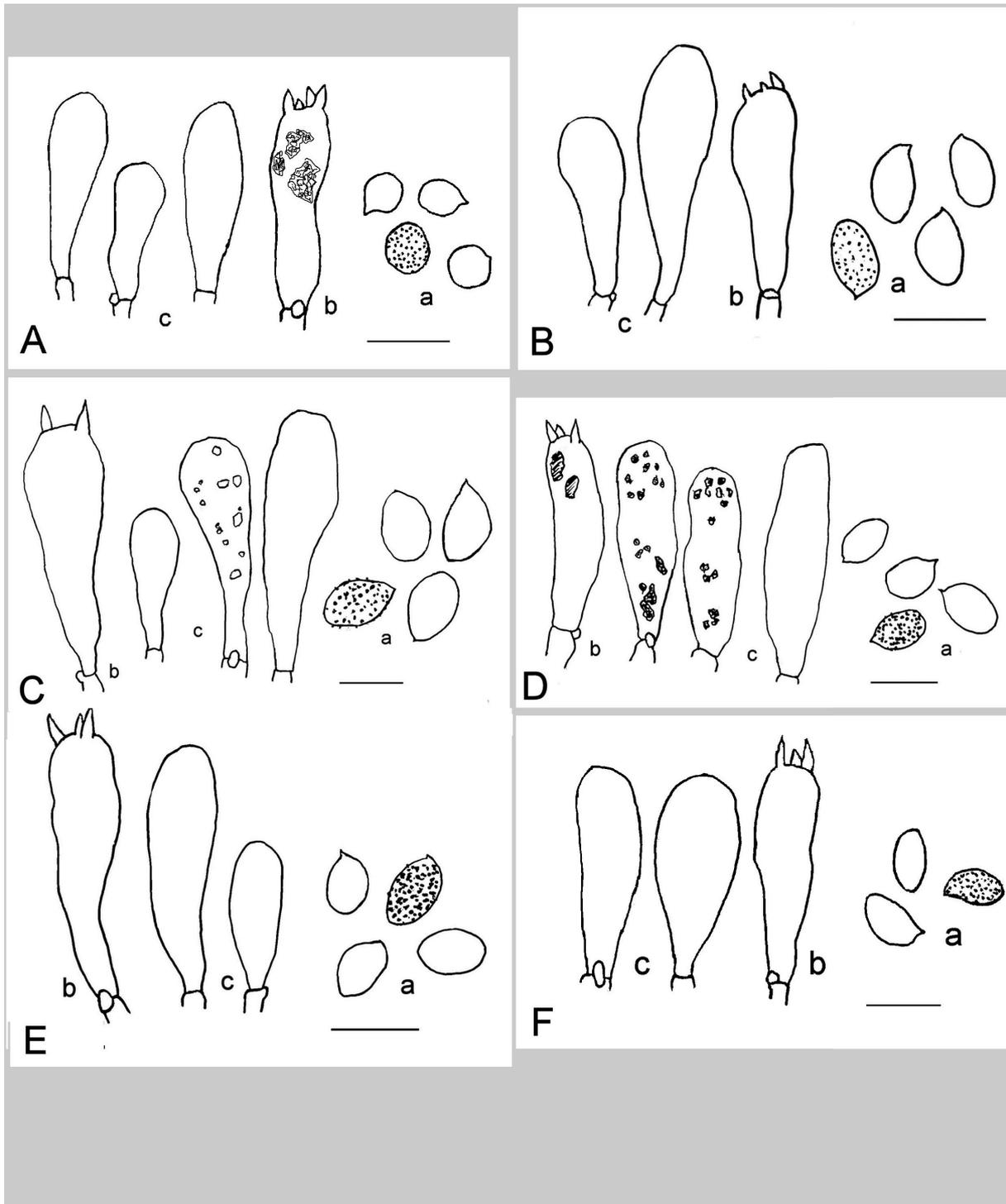


Figure 4 Microscopic details. A, *Cortinarius minilacus*; B, *C. peraurilis*; C, *C. pseliocaulis*; D, *C. rubrimarginatus*; E, *C. salmastrium*; F, *C. lanceolatus*.

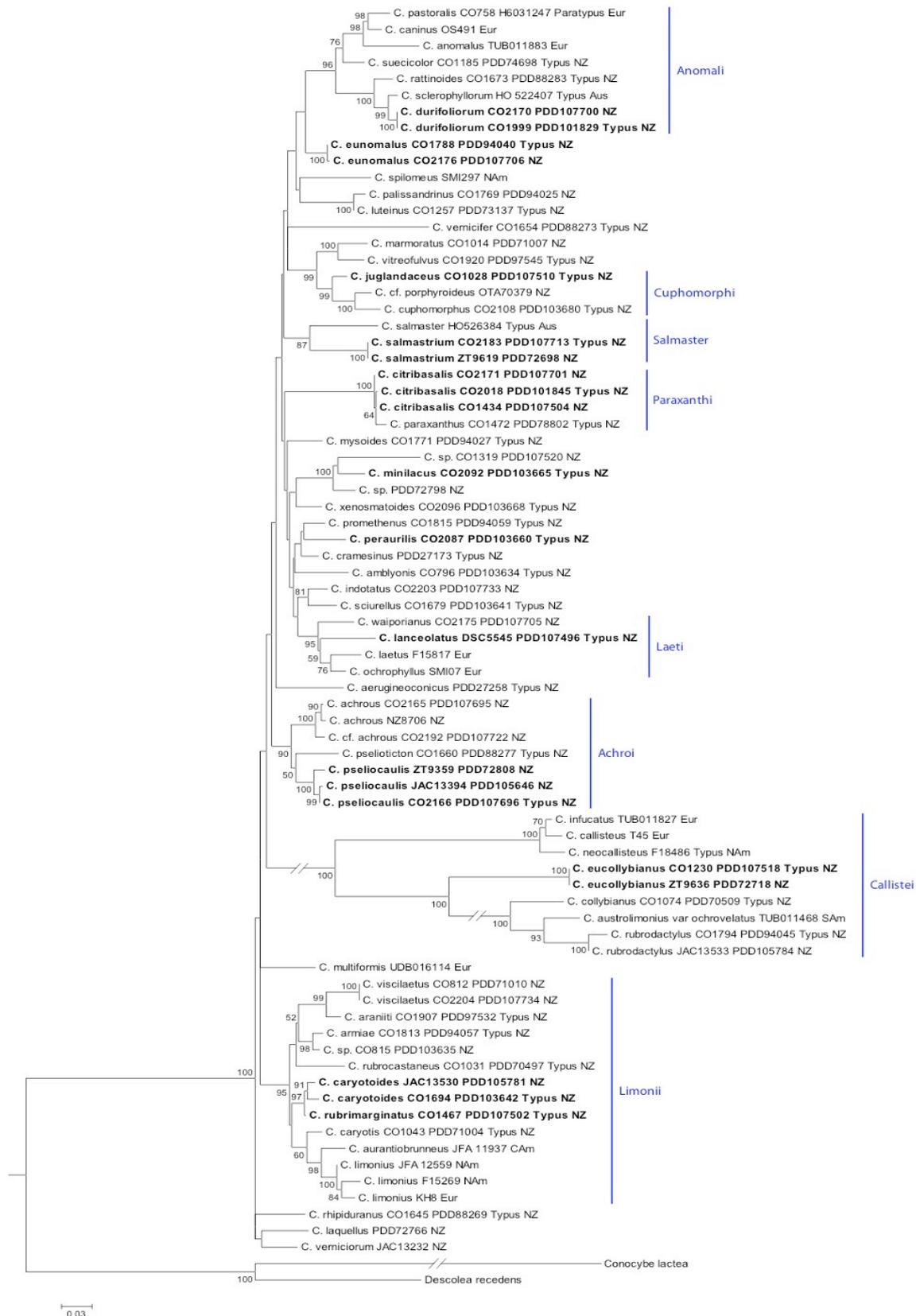


Figure 5. Maximum likelihood phylogenetic tree depicting the relationships among species treated in this study. New species are highlighted in boldface. Names of respective sections or clades are added. ML bootstrap support values are shown only above 50%. Scale bar indicates 0.03 expected changes per site per branch.