

On *Cortinarius* in Boreal Pine Forests

Karl Soop

Summary: The paper reports on observations of a number of interesting *Cortinarii* in boreal forests with special emphasis on the *Pinus* habitat. Similar taxa or forms that occur with *Pinus* and *Picea* are compared. Two new species are described and a few taxa are re-interpreted.

Note: Comments appearing in brackets [] have been added after publication.

1. Introduction

As is well known, the boreal and sub-alpine areas in Fennoscandia (Norway, Sweden, Finland) are largely covered by *Picea* and *Pinus* forests. Especially where the soil is calcareous, these vast expanses possess a rich, fascinating, and to some extent uncharted fungal flora. Many fungi are *Cortinarii*, especially from the subgenera *Myxacium*, *Sericeocybe*, and *Telamonia*. Over a period of many years I have studied a number of critical groups, concentrating on those few precious weeks of fruition before the frost appears, sometimes as early as the first days in September.

Why are these groups worthy of study? There is a singular challenge in deciphering the Northern mycoflora, our present knowledge about it being far from complete. To begin with E. FRIES, it is uncertain, and often highly implausible, that our great mycological father ever laid hands on many of the species that appear endemic to the combination of climate and habitat. Even if he were given or sent fruiting bodies from various sources (as we know he was), his active area seems to stop some 20-50 km north of Uppsala, as witnessed by the absence in his major works of several conspicuous species from the North (e.g. *C. calopus* Karst. and *C. canabarba* Mos.¹). Moreover, we still lack a monograph of the region, comprehensively, as well as one addressing a major genus, like *Cortinarius*. It is true that there are several works approaching the demand, where the Nordic Macromycetes Flora promises to be of special interest. Certain species reported by J. FAVRE in his well-known sub-alpine flora (1960) appear also in our area; on the other hand, we have observed many that either are absent in Favre's region, or if they exist, have not been seen or adequately reported by the Swiss mycologist. P.D. ORTON's works, including many Scottish species, also have some relevance, but one must remember that his area is not strictly boreal (being on the latitude of Southern Sweden). Even P.A. KARSTEN in Finland has described relatively few *Cortinarii* from the North.

It follows that, as one herborises in a conifer forest in Northern Sweden, one will meet a number of *Cortinarii* that are at the same time typical of the area and very difficult, if not impossible, to interpret in terms of extant literature. The situation in the *Picea* biotopes is less problematic as many species have been observed from similar habitats in the southern part of the country and on the Continent, and were quite probably included in Fries' and others' works. But in *Pinus* forests one will find a number of unknown taxa (and here the situation is to some extent paralleled in the genus *Tricholoma*). Exploring this biotope, especially in a calcareous region, at a time when its normally rather dry soil has been exposed to a long period of rainfall, you will discover a luxuriant and bewildering range of fruiting bodies, which are all the easier to detect against the uniform pale-grey *Cladonia* backdrop.

In a general way I have found that most coniferous *Cortinarii* seem to grow with either *Picea* or *Pinus*. In a few cases, however, they grow with both partners, but then they usually exhibit some distinct macroscopic difference (several examples below, and cf. BRANDRUD et al (1989), p. 28). For these reasons I feel one should be very careful in stating the habitat precisely. I have noticed

¹Note though, that *C. canabarba* may well be the *C. injucundus* (Weinm.) Fr. of Karsten.

that many authors tend to specify "conifers" in protologues, descriptions, and keys, without further qualification. Later authors then perpetuate the vagueness by copying the presumed habitat, or worse, exacerbate the error by stating "spruce or pine". It is evident to me that the mycorrhizal characters of the two sylvatic essences, as well as the geological and climatic properties of the corresponding biotopes, make a lot more difference than normally admitted.

I would like, in this paper, to contribute in a small way towards bridging the knowledge gap of the boreal mycoflora with some observations of *Cortinarius* with special emphasis on the *Pinus* habitat. Two new species are described and a few taxa are re-interpreted.

2. Subgenus *Sericeocybe*

2.1 *Cortinarius pseudomalachius* Reumaux and *C. impennis* Fr.

New finds and further study of the *C. impennis* reported in my earlier paper (Soop 1990b) has led me to conclude that the two taxa mentioned are in fact distinct species, each one connected with its partner:

Character	<i>Pinus</i> species	<i>Picea</i> species
Habit	large (cap 5-13 cm)	medium (cap 4-8 cm)
Gill density	crowded (L=60-108)	distant (L=40-50)
Stipital shape	bulbous, often sub-marginate	clavate

The pine species, a rare and remarkable fungus, seems to form a borderline case between *Sericeocybe* and *Phlegmacium* as emphasised by the three characters listed above (cf. the comments in my paper *loc. cit.*). It is evidently identical to *C. pseudomalachius* Reumaux, whose author says (1982): "rappellant un Scauri du groupe *cærulescens*", a most fitting description. P.D. ORTON (1958), in his description (sub nom. *C. malachius* Fr.), also points out these characters, albeit without suggesting a link to *Phlegmacium*. For a description, see the referenced papers by P. REUMAUX and myself.

[The epithet *pseudomalachius* being invalid, the species is now named *C. quarciticus* Lindstr.]

The spruce species can now be identified as *C. impennis*, especially as Fries' diagnosis agrees better with my finds (Soop *loc. cit.*) after abstraction of characters that are exclusive to *C. pseudomalachius*. Amended description:

Cortinarius impennis Fr.

Cap 3.5-8 cm; hemispherical, then broadly convex almost without an umbo.

Cuticle dry, moderately hygrophanous; purple-brown to red-brown (drying grey-brown), then tan with a violet margin, finally chestnut-brown; young with a violet sheen.

Stipe 6-8 cm x 9-17 mm; clavate, sometimes with a round bulb and slightly radicate; white to grey-violet, apex violet.

Veil violet to grey-violet, sparse; cortina white with a violet tinge.

Gills violet to grey-violet; adnate to free; rather distant: L=42-46, l=3; edge somewhat paler.

Flesh pale grey, marbled dark violet when young; smell faint, pleasant; taste faint vegetable-like.

Reactions: NaOH trivial; formalin nil.

Spores: 7-8 x 4-5 µm, elliptic.

Ecology: In spruce forests; uncommon. Västmanland, Arboga, Røfors, KS136 1986-08-11; Västmanland, Arboga, Kvisttorp, KS162 1986-08-31, Västmanland, Fellingsbro, Frötuna, KS571 1992-09-04.

This species, being pseudo-hygrophanous (rather like *C. malachus* ss Fr., which it resembles), could be regarded as either a *Telamonia* or a *Sericeocybe*.

[It is doubtful whether this is actually Fries' taxon and it has consequently been described as *C. carneinatus* Soop 2002.]

2.2 The Group Anomali

The taxa gravitating around *Cortinarius anomalus* (Fr.:Fr.) Fr. form a difficult group with many interpretations. I have observed what might amount to four taxa in the group, one of which appears boreal and bound to *Pinus*. They differ mainly in colour, velar distribution and, which I consider highly significant, in formalin reaction.

After the strong formalin reaction of *C. caninus* (Fr.) Fr. was pointed out to me (H. ROMAGNESI, *pers. comm.*), I have consistently applied the test to my collections, and in particular to related taxa in *Sericeocybe*. One result (Soop 1988) was the discovery of a positive reaction with *C. lanigeroides* Orton; I had previously observed it only with *caninus* and the closely related *C. tabularis* Fr. Since then, R. HENRY has published (1989) an extensive list of formalin reactions with Agaricales, where he includes *C. tabularis*, *C. emunctus*, and others; however, none in the subject group.¹

C. anomalus ss str. is normally found in *Betula* or mixed *Betula-Picea* association in our area. It is a common species with a greyish-brown cap, and usually with a distinct violet tinge on gills and stipe apex, at least on young specimens. There are normally a few sparse velar remnants toward the stipital base, forming one or two adpressed, yellow-tan girdles. The spores, like those of all relatives, are subglobose, measuring 7.5-9 x 6.5-7.5 µm. Formalin reaction negative or weak and very slow.

The name ***C. plumbosus*** Fr. was used by J. FAVRE (1960) for a *Telamonia* found in coniferous woods, and it has been argued (Moser 1989) that Favre's fungus is in reality *C. tortuosus* Fr., a position I regard as entirely plausible from several finds of this species in Sweden. On the other hand, I have always been struck by the appearance of Fries' icon and diagnosis (1851) of *C. plumbosus*, which clearly point to the *Anomali* complex. N. ARNOLD (1993) arrives at the same conclusion. In 1989 I found a *Cortinarius* in Western Sweden which fits the Friesian description, while at the same time undoubtedly being a relative of *anomalus*:

Cortinarius plumbosus Fr. nec Favre

Cap 2-3 cm; convex flattened.

Cuticle dry, weakly hygrophanous; chestnut-brown, drying greyish-brown; with a grey sheen.

Stipe 4-5 cm x 3-4 mm; cylindrical to slightly clavate, pale grey with a faint violet tinge, weakly fibrous.

Veil ochre to yellow, sparse; cortina not seen.

Gills young colour not seen, L=42, l=1-2; edge concolorous.

Flesh grey-brown; smell and taste insignificant.

Reactions: NaOH trivial; formalin, guayac nil.

Spores: 7.5-8.5 x 6.5-7 µm, subglobose, moderately verrucose.

Ecology: In a spruce forest in moss, near swamp. Västergötland, Fristad, Fagerås, 1989-08-17 KS375.

This fungus can easily be distinguished from *C. anomalus* ss str. by its dark colours and very thin veil. Taxonomically it should probably be regarded as a variety connected with spruce.

[It is probable that this species is conspecific with *C. lepidopus* (below).]

¹The test consists of applying a few drops of formalin in the flesh of a freshly cut fruiting body. If the test is positive, the flesh turns (bluish or reddish) lilac after 5-15 (20) minutes.

C. azureus Fr. was obviously regarded by its author as a separate species, while several contemporary mycologists have (at least privately) preferred to regard it as a variety of *C. anomalus*. It is not uncommon in *Betula* association in Sweden, where it differs from *C. anomalus* by darker colours, the cap being violet-grey and the gills dark violet. It is normally somewhat more robust, while the velar remnants are thinner, often not discernible on the stipe. These observations agree with those of P.D. ORTON (1958). More importantly, however, the taxon reacts with formalin, turning the flesh reddish-mauve after 10-20 minutes. Since I have not seen any intermediate forms, I prefer to regard it as a distinct species.

Cortinarius lepidopus Cke (= *C. anomalus* var. *cervicipes* Soop 1987, ined.)

Further study of this interesting taxon has confirmed my earlier suspicion (*loc. cit.*), that var. *cervicipes* must be identified as M.C. COOKE's fungus. The discrepancy in spore length must be regarded as minor, and is further attenuated by measurements of *C. lepidopus* by Orton (*loc. cit.*), whose description fits my finds excellently.

Cap 2-5(-8) cm; hemispherical, somewhat flattened, then convex flattened, often somewhat wrinkled, margin first involute, finally sinuous.

Cuticle dry, weakly hygrophanous; grey-brown with a greyish sheen, soon chestnut-brown, then umber with a yellow-brown margin, drying grey-brown; silky, young with small, pointed squamules, then silky, finally waxy, glabrous.

Stipe 4-7 cm x 4-6(-10) mm; cylindrical, sometimes with a small bulb; upper half grey-blue, lower half covered by yellow, often bristling girdles.

Veil ochre to yellow, often copious; cortina white, copious

Gills a saturated blue grey; free; L=32, l=1-2; edge concolorous.

Flesh grey-brown with a faint violet tinge in cap; smell and taste insignificant.

Reactions: NaOH trivial; formalin strong, mauve (20').

Spores: 7.5-8.5 x 5.5-7 µm, sub-globose.

Ecology: In a pine forest among *Cladonia*. Härjedalen, Sörviken, Hede, 1985-08-21 KS101, 1986-08-29 KS183, 1989-08-25, 1990-09-06.

In my earlier paper (*loc. cit.*) I regarded the taxon as intermediate between *C. spilomeus* (Fr.) Fr. and *C. anomalus*. In view of the remarkable formalin reaction, I now prefer to regard it as a variety of *C. azureus*.

[According to H. Lindström (Funga Nordica), the species grows with *Betula*.]

2.3 Section *Armillati*

Cortinarius paragaudis was extensively treated in my earlier paper (SOOP 1990a), where I concluded that the two taxa, differing in spore size, must be regarded as varieties of one species. This is now corroborated by BRANDRUD & al. (1992) who describe *C. paragaudis* subsp. *paragaudis* (smaller spores) and subsp. *œnochelis* Lindstr. Subspecies *œnochelis* is fairly common in boreal *Pinus* and *Picea* forests, where it is one of the few *Cortinarii* for which I have not observed any differentiating character due to the biotope.

Further study of the alkaline reaction of this species indicates that the velar remnants on the stipe of subsp. *œnochelis* tend to turn violet (as they do on *C. armillatus* Fr.), whereas those on subsp. *paragaudis* turn darker reddish-brown. I am not yet certain that the reaction is a consistent distinguishing character, but if further study would corroborate my results, one could conceivably promote the taxa to specific level.

[*Cortinarius paragaudis* var. *œnochelis* has been shown by molecular analysis to be a separate species, namely *C. luteoornatus* (Mos.) Bidaud & al.]

In this connection it is worth reporting that *C. (Telamonia) heterocyclus* Soop, described from a boreal *Betula* forest (SOOP 1990c), was found again in the following years, in its type location as well as in a few other stations in the area, always with birch. New tests show that its alkaline velar reaction is similar to that of subsp. *œnochelis* (even when the veil is in its initial ochraceous state).

This result is a strong indication that *C. heterocyclus* should not, as I proposed in the protologue, be considered a relative of *C. spilomeus* Fr., a species lacking this reaction. Instead it probably belongs to *Armillati*, where it is close to *C. hæmatochelooides* Hry (cf. CHEVASSUT & HENRY 1982).

[Molecular studies have shown that *C. heterocyclus* is not part of the section but in sect. *Craticii*.]

3. Subgenus *Phlegmacium*

3.1 *Cortinarius leucophanes* Karst. (1881)

This species is fairly common in rich boreal pine forests, where it usually grows among *Cladonia*.

Cap 3-6 cm; campanulate to convex with a broad umbo.

Cuticle viscous; non hygrophanous; ivory-white to creamy yellow or yellowish-grey to yellow-tan, sometimes slightly incarnate, young covered by a thin white frost with a pale-grey margin, old pale brown; glabrous.

Stipe 4-7 cm x 5-9 mm; clavate or slightly bulbous; filled; silky white, soft, greying on pressure, old with brownish-yellow fibers, apex sometimes violet.

Veil white, copious; cortina white.

Gills pale clay, usually with a fugaceous violet to pink tinge; edge concolorous; crowded (L=76, l=1); free.

Flesh white to pale violet, old yellowish grey in stipe, sometimes staining yellow-brown on exposure or on manipulation; soft; odour and taste insignificant.

Reactions: NaOH, NH₃ nil or weakly yellow.

Spores: 5.5-7.5 x 3.5-4 mm, elliptic.

Ecology: In sub-alpine forests of *Pinus sylvestris* among *Cladonia*. Härjedalen, Björnrike, KS122 1985-08-20, 1983-09-06; Härjedalen, Hede, Sörviken, KS439 1990-09-05; Västmanland, Arboga, Ramstigsberget, 1986-09-01; Södermanland, Vårberg, KS439 1987-09-06; Södermanland, Vagnhärad, Lövsta, with *Salix* in rich mixed woodland KS466 1990-09-23.

This is a smallish, "cute" *Cortinarius* with creamy colours and characteristically small spores. The gills are not always violet tinged, but when they are, the coloration soon turns pink and then quickly fades. The species is supposed to grow under pine with a boreal distribution, but it is sometimes also found in Central Sweden. In one collection, where the context had margarine yellow stains, *Salix caprea* was the only likely partner.

FRIES describes (1836) *Ag. compar* Weinm., a species that might be interpreted as *C. leucophanes* (T.E. BRANDRUD, *pers. comm.*). In fact, R. HENRY's description (1978) of *C. compar* fits quite well.

Systematically *C. leucophanes* is difficult to place. It undoubtedly belongs in the subgenus *Phlegmacium*, while at the same time showing an affinity with *Myxacium*, where similar species have small spores, a silky stipe, and a pale coloration (cf. the comments on the following species). In this, as in many other cases, one would wish that our modern mycologists had shown more respect for FRIES' taxonomy, where in particular the section *Elastici* in *Phlegmacium* appears to be singularly relevant (cf. SOOP 1989 re *C. vespertinus* Fr.).

3.2 *Cortinarius pinophilus* Soop n. sp.

This boreal fungus, superficially resembling the previous species, was discovered by H.G. TORESSON and the author in 1990. It was then found in many localities, and reappeared in 1992.

Cap 3.5-7.5 cm; hemispherical, then broadly convex, finally sometimes slightly upturned.

Cuticle faintly viscous to almost dry, somewhat waxy; non hygrophanous; evenly pale tan to a warm yellow-brown, young covered by a thin greyish-white frost, old leathery ochre; mat, minutely rugose; difficult to peel (50 %).

Stipe 4-10 cm x 6-14 mm; cylindrical with a distinct, rounded bulb (25 mm), sometimes clavate; filled; pale greyish-yellow, darkening with age, covered by a thin white layer, staining yellow on pressure (by absorption), apex white.

Veil and cortina white; sparse.

Gills pale grey, edge concolorous; fairly crowded (L=58, l=2); adnate to closely emarginate.

Flesh pale grey with a yellow tinge; faintly marbled yellow, sometimes darkening yellow in stipital base, grey horn line above gills; odour very faint, pleasant; taste mild.

Reactions: NaOH in flesh instantaneously lemon-yellow, then margarine-yellow, finally brownish-yellow, on stipe cortex and bulb yellow, on cuticle and gills trivially brownish; NH₃ approximately as NaOH; lugol, CuSO₄, guayac nil; formalin nil (15 min.).

Microscopy: Spores (7.5)8-9.5(10) x 5.5-6.5 μ m, elliptic, moderately punctuate; cystidia none; epicutis very thin (telamonioid); hypoderm with thick strings of a yellow pigment on hyphal walls, no gelatinised hyphæ.

Ecology: In sub-alpine forests of *Pinus sylvestris*, among *Cladonia*, in a calcareous region. Härjedalen, Hede, Sörviken, KS435 1990-08-26; Härjedalen, Björnrike, KS444 1990-09-06; spread over many localities in the area, perhaps 10 collections observed in 1990.

Despite an (almost) dry cuticle, this fungus should be placed in the subgenus *Phlegmacium* due to its crowded, phlegmacioid gills and strong alkaline reaction. Also the bulb, which can be quite distinct (though never marginate), points in this direction. The reaction indicates section *Variocolores*, where several *Phlegmacia* occur with an almost dry cuticle (e.g. *C. russus* Fr. and *C. patibilis* Brandrud & Melot).

The fungus grew mixed with several *Cortinarii* that it resembles macroscopically: *C. leucophanes* Karst., *C. arvinaceus* Fr., and a so-far unidentified *Myxacium* in the *C. causticus* group with a slightly bitter flesh and a sugary taste to the cuticle. Of these, *C. leucophanes* lends the most likely confusion, but this has a more whitish cap, sometimes a violet tinge to the gills (never observed in *C. pinophilus*), very small spores, and no distinct alkaline reaction.

A survey of the literature has come up with no certain identification. Perhaps the closest is *Phlegmacium minus* Vel., which, however, according to its author (1939), has a marginate bulb, a distinctly viscous cap, smaller spores (7-8 μ m), and grows in deciduous woods. *C. pinophilus* also resembles *C. norrlandicus* Brandrud, but this has no alkaline reaction and a brownish veil.

[Many finds of this species over the years, coupled with molecular data, seem to suggest that *C. pinophilus* should be placed, not in *Phlegmacium*, but in an isolated position in the phylogeny. The species has also been encountered in a wider area that includes Italy and North America.]

3.3 Section *Multiformes*

The *Pinus* form of *Cortinarius multiformis* Fr. ss Brandrud et al (1989) (= *C. allutus* Fr. ss auct.) differs from the very common *Picea* form in a few minute characters. The cuticle has a warmer, more golden coloration, resembling that of *C. langei* Hry found in *Fagus* association. I have also observed that the odour is somewhat unpleasant, whereas the taxon growing in spruce forest usually smells nothing, or at most faintly of honey. According to my observations, the spores are also smaller, as shown in the following table:

<i>C. multiformis</i> , <i>Pinus</i> form	7.5-8.5	x	4.5-5.5 μ m
<i>C. multiformis</i> , <i>Picea</i> form	8-10	x	5.5-6.5 μ m
<i>C. langei</i>	8-10.5	x	4.5-5.5 μ m

The spruce taxon sometimes appears with a more red-brown cap, faintly violet gills, and a darker, grey-violet tinge in the context (= *C. subhygrophanicus* (Mos.) Mos.?). I have always found this form together with normal, brighter specimens, though. Yet another form with a brick-red, more rugose cap (probably *C. allutus* var. *rufescens* Hry), reminding of *Leccinum aurantiacum*, was found in *Betula* association in the North. It seems intermediate between *C. aurantiacum* Mos. and *multiformis* (cf. Soop 1991a).

[The variety *rufescens* and *C. aurantiacus* ss Soop 1991a seem to be identical, and are in fact described by R. HENRY in 1958 as *Cortinarius rufoallutus*. The brick-red form is probably *C. caesiophylloides* Kytöv. et al.]

3.4 Other *Phlegmacia*

Observations of *C. scaurus* Fr. indicate that the pine form is generally paler than the spruce form, the cap being leathery yellow to pale tan, often without any olive tone at maturity, leading to easy confusion in the field.

After studying *C. guttatus* Hry found with spruce (Soop 1991b) and *C. sulfurinus* Qué. ss. Brandrud & al 1989 in pine forests, I now have little doubt that these taxa should be regarded as conspecific. The pine form smells rather like dill or parsley, whereas the spruce form exhales a more complex odour with a component of incense, while appearing otherwise identical.

I have previously described collections of *C. amurceus* Fr. (SOOP 1986), a rare species found in marshy areas with pine in the North. It obviously corresponds to *C. subtortus* Fr. with spruce. With a very broad conception of the species, one might consider it a variety of the latter; *C. amurceus* differs, however, in having yellow to citrinous colours (making it resemble *C. percomis* more than *C. subtortus*), the flesh staining reddish on manipulation and with alkaline solutions, and in lacking a bitter taste.

4. Subgenus *Myxacium*

In 1991 the pine forests in the North were populated by a beautifully yellow *Myxacium* of sect. *Defibulati* that I had not encountered in the previous years. It appears closely related to the very common *C. integerrimus* Kühn. (= *C. stillatitius* Fr. ss auct.), of which it might perhaps be regarded a variety. On the other hand, the fungus agrees well with Fries' diagnosis of *C. arvinaceus*, except that the author gives *Fagus* as the habitat.

Cortinarius arvinaceus Fr.

Cap 4-5.5 cm; obtusely conical, then broadly campanulate to almost nummular; margin somewhat wrinkled with age.

Cuticle glutinous; non hygrophanous; evenly bright yellow to pale yellow, centre slightly more brown-yellow, margin young yellowish-white.

Stipe 8-12 (-15) cm x 7-12 mm; glutinous; cylindrical, often with a tapering base, rather stiff; silky white, often young with a faint violet tinge on upper half, staining yellow-brown with age.

Veil white with a faint violet tinge, copious; cortina white; copious.

Gills white to pale grey, edge concolorous; L=46, l=2-3; adnate to closely emarginate.

Flesh white, pale yellow near cutis, somewhat brownish-yellow in stipe base; rather soft; odour mostly faint, pleasant, of honey; taste mild, faintly sweet.

Reactions: NaOH trivial; guayac nil.

Microscopy: Spores 11.5-14.5 x 6.5-8 μ m, amygdaloid, moderately punctuate; no clamps seen on hyphæ; cystidia balloon-shaped, 20 μ m broad protruding 30 μ m.

Ecology: In sub-alpine *Pinus* forests among *Cladonia*. Härjedalen, Hede, Remmen, KS496 1991-08-29; observed in several other locations in the area.

C. arvinaceus can not be said to strictly correspond to *C. integerrimus* from the *Picea* biotope, since the latter also occurs with pine, where it displays the same wide colour range as one usually finds in its common habitat. One should note, however, that this range does not include the striking yellow coloration of the subject taxon, providing a clear discontinuity, even if one considers the greyish-clay to pale olive-yellow shades sometimes found with *C. integerrimus*.

5. Subgenus *Telamonina*

5.1 Section *Brunnei*

Many *Cortinarii* in the boreal and sub-alpine area belong to *Brunnei*; that is, the fruiting bodies darken as they develop at maturity (not to be confused with the effect of decomposition). Darkening occurs with the cap cuticle and gills, and to some extent with the stipital cortex and context. The exsiccata become very dark, often soot black, ash grey, or brownish black.

The group has many members, and I want to restrict myself to medium-sized or large fungi, not treating the many small *Telamoniae* that are regularly found in the subject area and that all darken more or less. *C. depressus* Fr. (= *C. adalberti* Favre), often found in the North, is a borderline case: it is usually small, but I have found fruit-bodies with caps up to 8 cm (!) in diameter. This species, as well as *C. uraceus* Fr., are quite distinctive, but will not be discussed as I have only observed them in *Picea* forests.

***Cortinarius brunneus* Fr.**

This is, of course, the most ubiquitous member of the section. It is characterised by the purple-brown to umber colours and rather short spores (8-9 x 6-6.5 µm). It grows mainly with *Picea*.

The form found with *Pinus* differs in having a very thin veil that quickly vanishes during development of the fruiting body. It has sometimes been reported as being smaller (cf. the *Sphagnum* form mentioned by Fries, 1851); I have found it of the same average size as the *Picea* form, but with a more slender stipe and a conical cap. I have no doubt that the *C. rubricosus* Fr. of Ricken, Moser (cf. the picture in Michael et al. 1985), and perhaps of Lange (1938), is this taxon, and I have previously reported it under that name (Soop 1987). After re-examination, however, I now conclude that it must be relegated to a form, or at best a variety, of *C. brunneus*. The var. *glandicolor* (Fr.:Fr.) Lindstr. & Melot (in Brandrud & al 1992), though somewhat smaller, may well be this form. I have never found the pine form under spruce, nor vice versa.

[The *Pinus* form has later been described as *C. clarobrunneus* Lindstr. *C. glandicolor* has been shown to be a good species, as originally conceived by Fries. *C. rubricosus* was described by Fries as a broad-leaf associate.]

***Cortinarius brunneogriseus* Soop n. sp.**

I have found this fungus many times over the years in the calcareous pine forests of Härjedalen, without being able to attach an existing name to it. Yet, it is a question of a fairly conspicuous, distinct taxon, not too rare in the area.

Cap 4-10 cm; fleshy, hemispherical, then convex with broad umbo; margin down-turned, long involute.

Cuticle dry, hygrophanous; grey-brown to greyish-tan, centre more reddish-tan; young coarsely covered by white fibrils, except in the centre, at maturity mat with radial hygrophanous veins and coarse brown fibrils; margin young with white fibrils.

Stipe 8-15 cm x 9-16 mm; robust, clavate (base <38 mm), spongy; pale grey-brown with white fibrils, darkening to dirty brown, sometimes with a lasting white velar zone; young often with a bluish tint at apex.

Veil white, sparse to moderately copious, non-darkening; cortina white, sparse.

Gills cinnamon; L=36-46, l=2-3; broad; broadly emarginate.

Flesh pale grey-brown, marbled cinnamon; exsiccata blackening; odour and taste faint, pleasant, agaricoid.

Reactions: NaOH trivial (blackish-brown); formalin, guayac, AgNO₃ nil.

Spores: 7.5-9(9.5) x 4.5-6 µm, obtusely elliptic, somewhat angular, moderately verrucose.

Ecology: Pine forest with *Cladonia*. Härjedalen, Hede, Sörviken, KS437 1990-08-25, KS442 1990-09-05; Hede, Remmen, KS502 1991-08-30, KS511 1991-08-31, many collections in the area 1986-91.

The species, apparently boreal and *Pinus*-bound, is related to *C. brunneus*, but differs in a thinner, non-darkening veil, more greyish colours, a more robust profile, and leaner spores (see Fig. 1). In particular, the veil remains white, whereas it darkens with the fruiting body of *C. brunneus*. The

taxon appears to be related to *C. brunneus* var. *clarobrunneus* Lindstr. & Melot (in Brandrud & al, 1992), but forms, to my mind, a clearly separate species.

For a while, I used the name *C. bovinus* ss Lge (cf. Soop 1987), but as I mentioned in a later paper (Soop 1990b), I now believe Lange's species to be *C. bulbosus* Fr., a *Picea*-bound fungus with a non-darkening context and longer spores, found mainly in the South and related to the group *Privigni*. Nevertheless the subject species fits Fries' diagnosis (1851) of *C. bovinus* in several respects. Coloration and habitat agree; it is hygrophanous, and Fries lists *C. bovinus* just before *C. brunneus*, while mentioning its affinity to *C. bulbosus*. But the stipe is said to be "*zona fusca simplici cinctus*", which holds for neither the subject nor Lange's taxon.

I have unsuccessfully looked for the species in Central Sweden and conclude that it is highly implausible that it was seen by Fries. I have not found it in the literature and therefore propose it as a *nov. sp.* It is rather similar to *C. suberi* Soop (1990a), a species associated with spruce, from which it differs by being frankly hygrophanous, and by having a thinner veil and slightly larger spores.

[This taxon has later been subsumed as a variety *brunneogriseus* of *C. suberi* (Soop 2002). Moreover, molecular analysis has shown that it is identical to the type.]

I have also found very similar taxa associated with *Picea* and *Betula* in the North, with progressively longer spores (8.5-10.5 and 9.5-11.5 μm , respectively). The former has a redder hue to the cuticle, whereas the latter is more grey, often with a slender habit. It is yet too early to evaluate the taxonomic relationships in this complex, but it is possible that the *Betula* taxon, which was also found in the South (Västergötland) in 1992, can be identified as *C. riculatus* Fr.

[The *Betula* taxon has since been identified as *C. disjungendus* Karst. — The *Picea* taxon with longer spores may be interpreted as *C. privignus* Fr.]

***Cortinarius* cf. *privignus* Fr.**

I have collected several taxa that might be attributed to this epithet, in both coniferous biotopes considered. The collections may be split into those that darken (notably the *exsiccata*) and those that do not, while otherwise lacking significant distinguishing characters. The non-darkening taxa approach *C. biformis* Fr., collections of which were described in an earlier paper (SOOP 1990b; cf. below).

The following description (of "*privignus*-K" in Fig. 1) pertains to a darkening taxon found with both coniferous partners. The form under *Picea* differs by having somewhat brighter (red-brown) colours.

Cap 2.5-5 cm; obtusely conical, then convex with a broad umbo.

Cuticle dry, concentrically hygrophanous; brown with a faint purple sheen, centre more chestnut-brown, drying orange-brown; finely innate fibrillose; margin young with thin white fibrils.

Stipe 5-9 cm x 7 mm; slender, often long and curved, cylindrical; pale brown with a thin white cover that easily absorbs, young with a fugaceous violet tint at apex, mycelial base white.

Veil white, sparse; cortina white, fugaceous.

Gills pale cinnamon; L=36, l=1-2; broad; broadly emarginate; edge finely dentate.

Flesh pale brown to tan, marbled darker brown; *exsiccata* blackening; odour faint (of gooseberry?).

Reactions: NaOH trivial.

Spores: 8-9 x 5-6 μm , obtusely elliptic, moderately verrucose.

Ecology: Pine forest with *Cladonia*. Härjedalen, Hede, Sörviken, KS123 1985-08-26, KS318 1988-08-14; spruce forest with *Vaccinium myrtellinosum*.

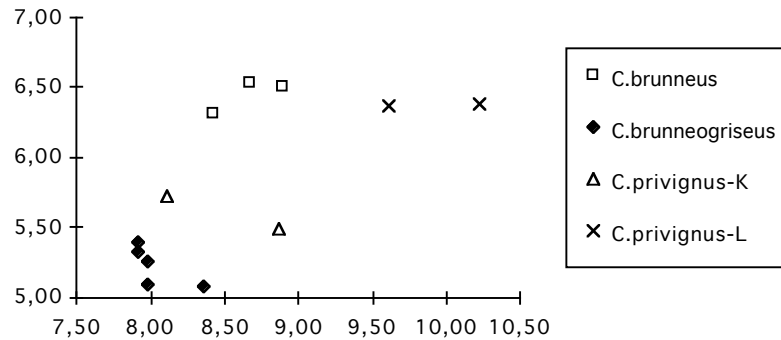


Fig. 1: Spore measurements (collection averages in μm) in section *Brunnei*

These collections bring up the interesting question whether one can ascribe taxonomic significance to darkening exsiccata. On several occasions I have found macroscopically identical fruiting bodies, with identical spores, in two separate locations, which after careful drying become greyish black from one location but not from the other. The collections were taken under similar, favourable, meteorological conditions and consisted of fresh fruiting bodies of all ages. Moreover I have observed this dichotomy in at least two boreal species, of which the above is one.

[Despite some differences, the described taxon ("*privignus-K*") is now identified as a form of *C. brunneus*. — The taxon "*privignus-L*" is most probably identical to *Cortinarius fuscobovinus* Kytöv. & al.]

5.2 Other *Telamoniae*

C. armeniacus Fr. is normally a spruce symbiont, but I have also observed it in boreal pine woods. It is then more chestnut-brown, and can even have a faint violet tinge on the stipe apex. It is possible that one should assign varietal status to this taxon. Note, that this is not the dark red-brown variety (*badius* Schum. = *C. triformis* Fr. ss Mos., Marchand) earlier reported from spruce forest (Soop 1987).

C. biformis Fr. is another spruce symbiont sometimes found with pine. As is often the case, this form is darker, with a purplish umber shade in all its parts. The forms found with *Picea* vary considerably in colour: the cap can be reddish-brown to purple, yellow-brown to honey yellow, or greyish-brown to almost grey. As earlier reported (Soop 1990b), all these forms seem to blend with the three forms of *C. triformis* Fr. (nec Mos., Lge), having the spores, the habit, the faint bluish tinge on the stipe apex, the browning context, and the white band on the stipe, in common.

[The taxonomy of this complex is further discussed and unravelled in Soop 2002 (Journal des JEC 4).]

6. Notes on Other *Cortinarii*

Obligatory pine companions observed in the boreal or sub-alpine area include the well-known ***C. palustris*** (Mos.) Mos. (in swamps), and the very common ***C. mucosus*** (Fr.) Fr. (*C. mucifluus* Fr. I have only observed in the South).

I have observed a few species that occur with either coniferous partner in the boreal area, without being able to detect any consistent distinguishing character related to the biotope. These include ***C. camphoratus*** Fr., ***C. traganus*** Fr., ***C. vibratilis*** (Fr.) Fr., ***C. turmalis*** Fr., and the very common ***C. croceus*** (Schff.:Fr.) Britz. (with a myriad forms, doubtfully attributable to the biotope).

7. Taxa Nova

Cortinarius pinophilus Soop sp. nov.

In silvis borealibus cum Pineis, Phlegmacium ad Varietatum sectionem pertinens, at minor, subsiccus. Pileo 3,5-7,5 cm lato, hemisphaerico, deinde convexo, haud hygrophano, parum viscido atque subsiccato, in ceræ substantiam cogi; stramineo-helvolo, primo subtiliter albosericeo, ætate ochraceo. Stipite cylindrico subovato-bulboso vel clavato, pallide griseoluteo, tactu gilvescente. Lamellis pallide griseis, fere confertis. Carne pallide grisea, sublutescente, in basi stipitis sæpe luteofurvescente; odore saporeque debilibus, mitibus. Velo cortinaque albis, fugacibus. Sp. ellipsoideis, 8-9.5 x 5.5-6.5 µm. React. NaOH ope splendide citrino-lutea, mox gilva. Holotypus in herb. auct. sub num. KS444 adservatum est.

Cortinarius brunneogriseus Soop sp. nov.

In silvis borealibus cum Pineis, hygrophano, sicco, solido, C. brunnei Fr. et C. suberi K. Soop affini. Pileo 4-10 cm lato, obtuso, deinde convexo, brunneogriseo, disco leviter rufo, primo grosse sed haud dense albofibrilloso. Stipite clavato, cum pileo concolori at pallidiore, fusciscente, sæpe albocingulato, in apice interdum violaceo. Lamellis cinnamomeis, subdistantibus. Carne concolori, cinnamomeo-marmorata; exsiccato nigrescente; odore saporeque debilibus, mitibus, amœnis. Velo cortinaque albis, fere fugacibus. Sp. obtuse ellipsoideis, 7.5-9 x 4.5-6 mm. React. NaOH ope vix insignis. Holotypus in herb. auct. sub num. KS511 adservatum est.

Cortinarius armeniacus Fr. var. *badius* (Schum.) Soop stat. nov.

Basionymon Ag. armeniacus Fr. f. d: badius, in Systema Mycologicum, 1821 p.234, et C.F. Schumacher in "Enumeratio plantarum in partibus Sællandiaë septentrionalis et orientalis", 1803 p.327.

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Cortinarius pinophilus Soop sp. nov., holotype collection



Cortinarius brunneogriseus Soop sp. nov., holotype collection



***Cortinarius armeniacus* Fr. var. *badius* (Schum.) Soop stat. nov.** KS-CO148, Röfors, Västmanland, Sweden