Mycological Notes 40: The family Bolbitiaceae in New Zealand

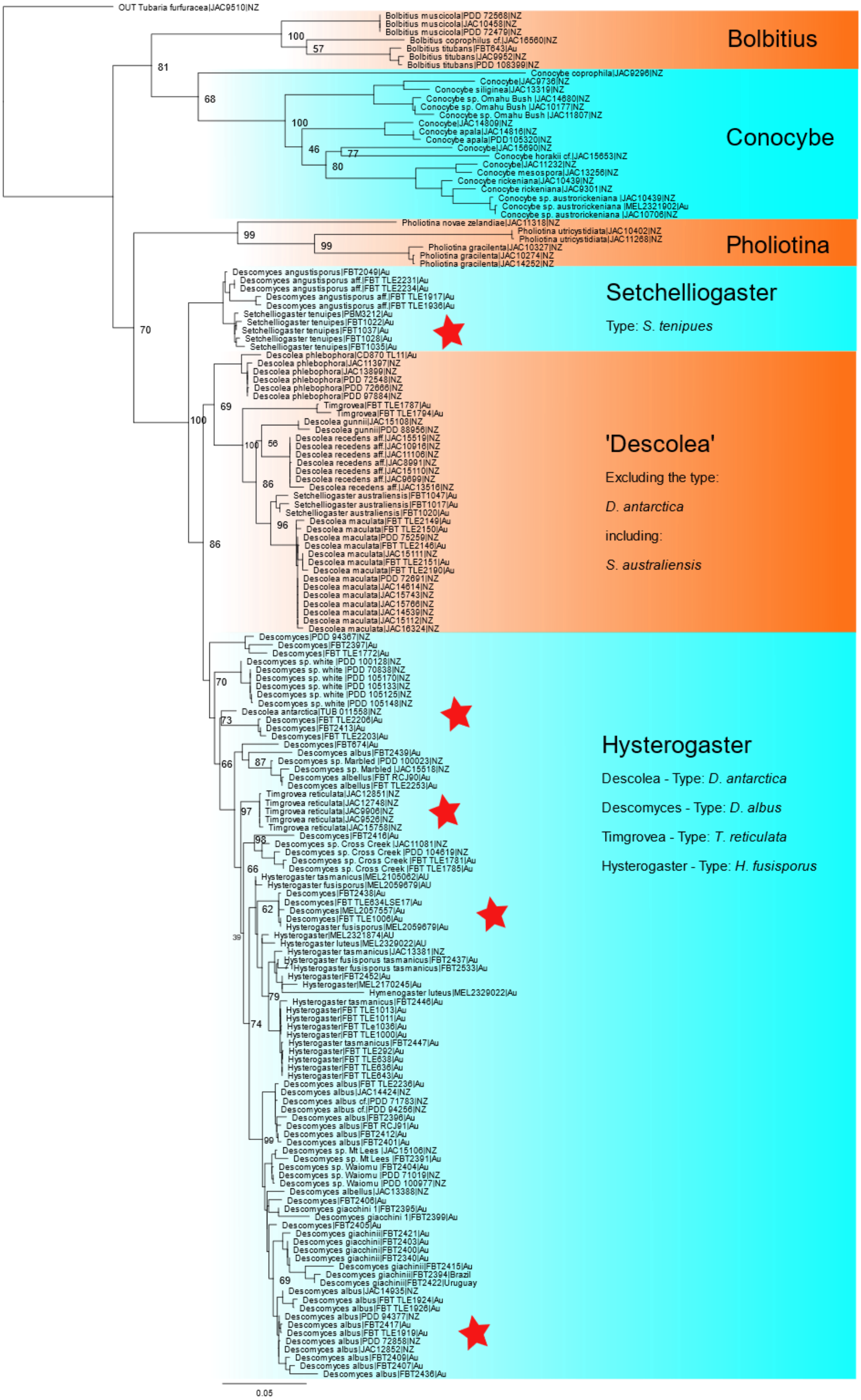
Jerry Cooper, August 20th 2020 [some revision June 2023]

Introduction

As usual with my informal 'Mycological Notes' this is a very preliminary outline of the current New Zealand data for the species in this family. Many of the collections are cited with my personal accession numbers (JAC) but all are deposited in the PDD national fungarium. More details may found on each collection by searching for these numbers on the Systematic Collection Data website (https://scd.landcareresearch.co.nz/). The sequence data will be deposited in GenBank when my studies are completed.

The Bolbitiaceae is a family of agarics containing relatively few genera traditionally characterised by small, fragile fruitbodies, often with long stems, a cinnamon spore print colour and most significantly a hymeniderm (cellular) cap surface. The family was last revised in New Zealand by Roy Watling and Marie Taylor in 1987. At that time, the family was thought to include just *Agrocybe*, *Conocybe* and *Bolbitius*. The genera making up family have changed in recent years because of insights provided by phylogenetic information from gene sequencing. In 2014 I used the data generated during the US-led Assembling the Fungal Tree of Life project (Spatafora, 2005) and added many New Zealand species to see where they fitted into the phylogeny (Cooper, 2014). In that tree it may be seen that *Agrocybe* falls-out in two places and neither is within the Bolbitaceae. *Agrocybe erebia*, which is closely related to our *Agrocybe parasitica*, is sister to, or within the Tubariaceae, and I predicted it would need a new generic name, and I suggested *Aporocybe*. The more appropriate genus *Cyclocybe* was resurrected for this segregate shortly afterwards. The family-level phylogenetic position of *Cyclocybe* remains a bit uncertain in my view, but it is not within the Bolbitiaceae. The second group of *Agrocybe* species, including the type species *A. praecox,* probably resides within the Strophariaceae in a broad sense, and this group keeps the generic name *Agrocybe*. So, this group of *Agrocybe* is also not within the Bolbitiaceae. A third New Zealand species *Agrocybe olivacea*, is different again and is related to *Agrocybe rivulosa* spreading globally on wood chips, and these two species probably need another new generic name. They too do not belong in the Bolbitiaceae. On the other hand, it can be seen in my 2014 tree that *Descolea* is within the Bolbitiaceae, and that was already known from sequence data since 2002. In prior treatments it was placed within the Cortinariaceae, although Rolf Singer back in 1969 correctly suggested it belongs in the Bolbitiaceae. Both *Descolea* and its secotioid/truffle-like versions *Descomyces*, *Setchelliogaster* and *Timgrovea* all belong in the Bolbitiaceae. Species in these genera are unusual in having a Gondwana distribution. All the species in these genera are ectomycorrhizal, unlike *Conocybe*, *Agrocybe* and *Bolbitius* which are saprophytes. It has been proposed the highly distinctive New Zealand endemic secotioid *Tympanella galanthina* belongs in the Bolbitiaceae (or the Tubariaceae), but it is more closely related to the Strophariaceae. Figure 1 shows a current phylogenetic tree of representative taxa in the family Bolbitiaceae.

Figure 1: ITS+LSU Maximum Likelihood phylogenetic tree of selected taxa in the Bolbitiaceae. Bootstrap support values from 1,000 trees. Red stars indicate generic types.



The ectomycorrhizal group – *Descolea*, *Descomyces* and allied genera

Nomenclatural and interpretive Issues

Here I will dive into some nomenclatural and interpretative issues in this group. These details are probably not of interest to most readers unless you want to know how and why names should be applied to this group.

In a recent analysis by Kuhar et al 2017 based on ITS data the authors recognised a single broadly circumscribed genus *Descolea* for the monophyletic clade incorporating *Descomyces*, *Descolea*, *Setchelliogaster* and *Timgrovea*. They showed that gasteroid and secotioid forms had arisen several times independently within the group and so embraced a generic concept that combines the agaricoid, secotioid and gasteroid forms. Accordingly, the authors made recombinations in *Descolea* for all the taxa originally described in *Descomyces*, *Timgrovea* and *Setchelliogaster*. This approach is pragmatic, but it remains to be seen if it catches on. Within the broader monophyletic group the majority of agaricoid taxa form a well-supported monophyletic subclade (excluding *Descolea inferna* which seems unresolved in my ITS analysis). On morphological grounds it might still be preferable to continue to recognise this supported agaricoid group at generic level. Unfortunately, the name for this group cannot be *Descolea* because the type species of the genus, *D. antarctica*, occupies an anomalous position elsewhere within the gasteroid clade. There are no suitable available generic names available for this agaricoid group. One solution to this problem would be to conserve the generic name *Descolea* against a new type, perhaps *D. phlebophora*. However, it should be noted the clade does contain both (near) secotioid and gasteroid forms in addition to the agaricoid species.

It is clear the secotioid/gasteroid forms have arisen multiple times in this group. The secotioid *Setchelliogaster tenuipes* lies in a well-supported clade and could continue to be recognised as a good genus. However, that does raise a couple of problems. The first is the closely related *Descomyces angustisporus* is not secotioid and does look exactly like a *Descomyces*. In addition, *S. australienisis* would need moving to *Descolea* (under a new conserved type for the genus). Thus, there is no morphologically easy way to recognise *Setchelliogaster* as a separate genus. The gasteroid genera *Descomyces* and *Timgrovea* then form the remaining clade.

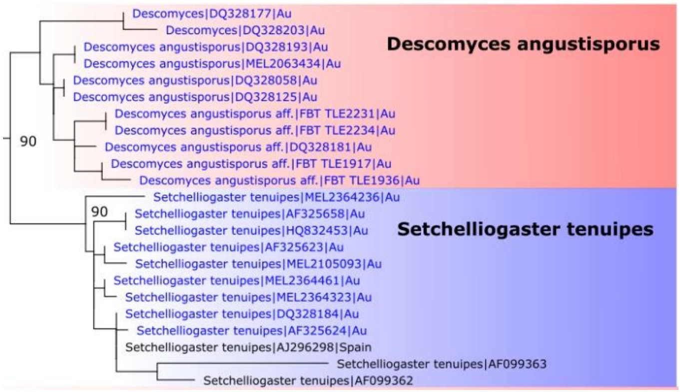
This remaining *Descomyces*/*Timgrovea* clade is also problematic because it contains the type species of *Descolea*, *Descomyces*, *Timgrovea* and, according to recent data, *Hysterogaster*. A New Zealand collection I identified as *H. tasmanicus* is within this group and is closely related to several more recent sequences of Australian material identified as *Hysterogaster*. So, which is the correct generic name to use from these available alternatives? We need to consider the dates of publication of the various names to establish priority. The type species of *Descolea* is *D. antarctica* (1952), whilst for *Setchelliogaster* it is *S. tenuipes* (1958), for *Timgrovea* it is *T. reticulata* (1993), for *Descomyces*, *D. albus* (1993). The name *D. albus* requires epitypification to stabilize the use because it is currently being interpreted variously. Finally, the type species of *Hysterogaster* is *H. fusisporus* (1928). Clearly, priority must be given to *Hysterogaster* which pre-dates all other names including *Descolea*. For that reason, *Descolea* is not the correct name for this group whether treated in a broad sense including agaricoid/secotioid and gasteroid forms (Kuhar et al), or even for the name of a sub-clade if the majority of agaricoid forms are named separately to the majority of secotioid/gasteroid forms.

So, what is the solution to this abundance of generic names and a broad circumscription versus narrow? I am currently uncertain, and I think a more inclusive multi-gene analysis including some protein-encoding genes is required. There are clear differences in topology between my ITS+LSU versus ITS-only analyses and that raises suspicions.

Part of me would like to see *Descolea* conserved against a new generic type just for the majority of agaricoid forms. The consequence then being continued recognition of *Setchelliogaster*, even though it is tricky to recognise from morphology as a segregate genus, and then to treat all the gasteroid species currently described under *Descomyces* and *Timgrovea* as species of *Hysterogaster*. Alternatively, I suppose it is perhaps more pragmatic to treat everything as *Hysterogaster*, unless there is another conservation proposal to replace it by a broad *Descolea*. I will continue to recognise the various names in *Descolea*, *Descomyces*, *Setchelliogaster* and *Timgrovea* until this analysis and naming situation is resolved more formally.

Setchelliogaster

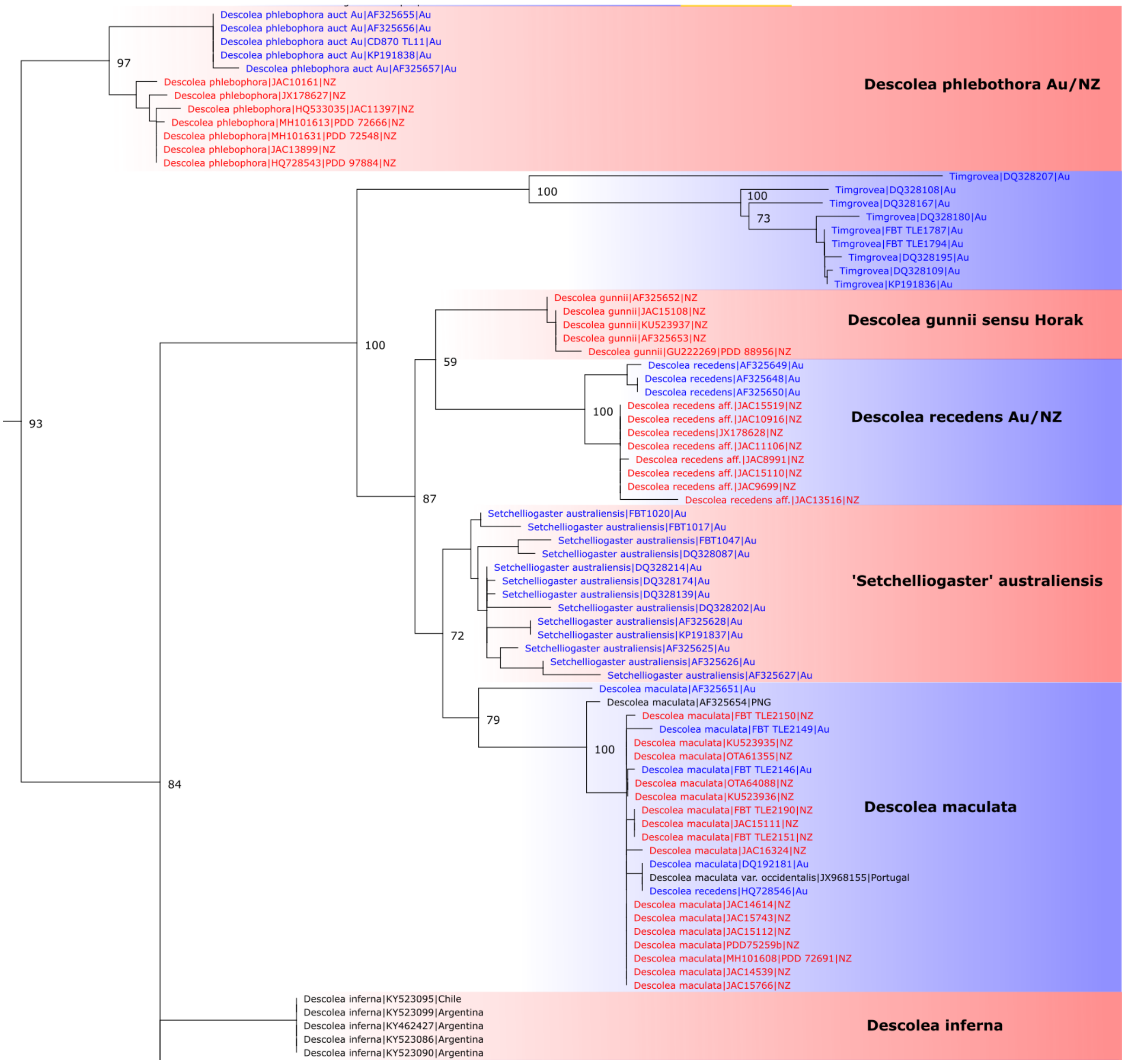
Figure 2: ITS-ML Setchelliogaster



There are no currently known New Zealand collections of *Setchelliogaster*, but it has been recorded with *Eucalyptus*. See also the discussion under *Descolea gunnii.*

'Descolea'

Figure 3: ITS-ML '*Descolea'* (excluding the type species *D. antarctica*)



In his 1971 monographs of *Descolea* Horak described three species present in New Zealand. *Descolea majestatica* is a slimy capped species that we now know is a *Cortinarius*. *Descolea phlebothora* is easily recognised by the wrinkled cap. *Descolea gunnii* was the only other described species. We now know the name *Descolea gunnii* has been misinterpreted and widely misapplied to at least three separate taxa.

Table 1: Key to 'Descolea' and Setchelliogaster in New Zealand

1	Frb secotioid. With *Eucalyptus* [no specimens]	*Setchelliogaster tenuipes*
1	Frb agaricoid	2
2	Cap with white veil remnants. [no specimens – and in Descomyces clade]	*Descolea antarctica*
2	Veil remnants, if present, brown. With Nothofagaceae or myrtaceae.	3
3	Cap conspicuously wrinkled.	*Descolea phlebophora*
3	Cap not conspicuously wrinkled.	4
4	Stipe base without scales but covered with a uniform brown tomentum remnant of veil (common species). Nothofagaceae and Myrtaceae.	*Descolea sp. 'Hinewai'* [*Descolea recedens* aff.]
4	Stipe base with girdles or scale-like tufts of veilar remnants (uncommon species)	5
5	Spores clearly verrucose. Cheilocystidia easily observed and clavate/cylindrical. With Nothofagaceae only?	*Descolea gunnii* sensu Horak
5	Spores minutely verrucose. Cheilocystidia forming an agglutinated band, hard to discern, generally broad. With Myrtaceae only.	*D. maculata* aff.

Setchelliogaster tenuipes

The Type is from California with Eucalypts in 1907. Reported from New Zealand with *Eucalyptus*. See the discussion under *D. gunnii* sensu Horak.

Descolea antarctica

No deposited material available for examination and no specific collection details for the purported New Zealand collection. Potentially an error.

Descolea phlebophora

Easily recognised by the wrinkled cap. No specimens associated with tea-tree have been sequenced and may be the same as the Australian species, which requires a different name.

JAC11397	JAC13899

PDD 72666 (Photo E, Horak)

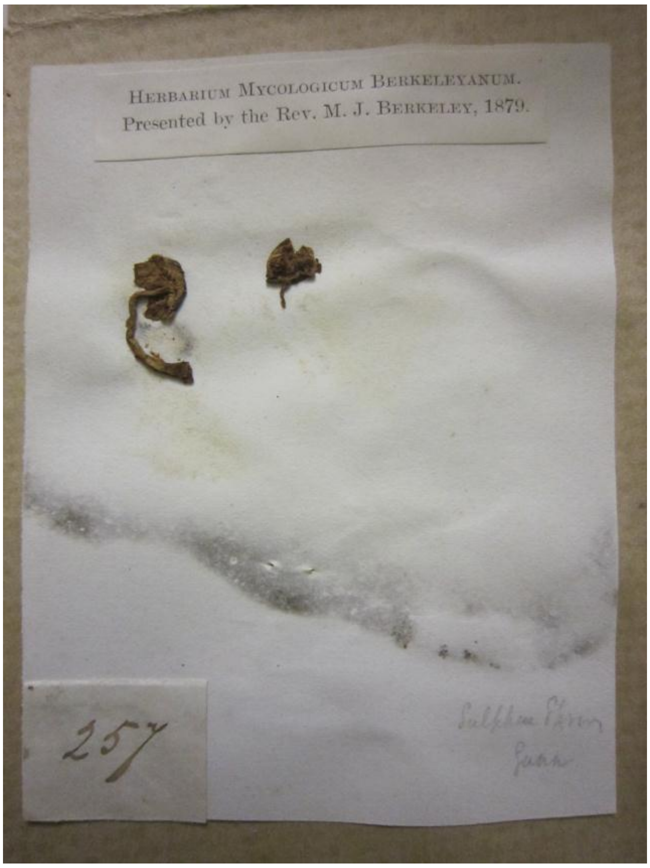
Descolea gunnii

With this name we need to take a detour to look at some outstanding taxonomic problems.

Egon Horak established the modern interpretation of *D. 'gunnii'* in 1971 but there are some issues to resolve and it is probable this species has been misinterpreted by more recent workers, and in multiple ways. The great British mycologist Miles Joseph Berkley (1803-1889) first used the name *Secotium gunnii* for a collection that was apparently sent to him by Ronald Campbell Gunn (1808-1881) living in Tasmania. Berkeley did not formally publish the name but seemingly added the name *Secotium gunnii* to the associated notes.

Berkeley was a clergyman in Northamptonshire and active in mycology from 1828 until his death in 1889. He had an extensive network of contacts around the world from whom he received collections. He also received collections via the Royal Botanic Gardens at Kew, especially from the botanists William Jackson Hooker (1785-1865), Joseph Dalton Hooker (1817-1911), and the mycologist Mordecai Cubitt Cooke (1825-1914). The Daltons and Cooke also had extensive networks of contacts which included New Zealand's William Colenso (1811-1899), responsible for many early records of New Zealand fungi, and Ronald Gunn who was 'superintendent for convicts' in Tasmania. Gunn and J.D. Hooker corresponded for 20 years between 1840 and 1860 (Endersby, 2001). The epithet 'gunnii' applied by Berkeley strongly suggests this material was sent to Joseph Dalton Hooker by Gunn in Tasmania and subsequently forwarded to Berkeley. Berkeley's herbarium of 9,000 collections was gifted to Kew in 1879. The collection of *Secotium gunnii* was subsequently 'mounted' (inappropriately like a pressed plant specimen) and remains at Kew as part of Berkeley's Fungarium (Fig. 4). It is simply annotated "*Sulphur Springs, Gunn*".

Figure 4: the type collection of *Secotium gunnii* from the Berkeley collection at Kew (photo courtesy of Paul Kirk, RBG Kew).



The name *Secotium gunnii* was formally published by George Massee (1845-1917), also working at Kew. He described the species in an article including several gastroid fungi from the Kew collections (Massee, 1890). The species he described are from Australia (WA, Tasmania, Victoria, NSW), USA, Ceylon and New Zealand. Massee's description of the *Secotium gunni* collection concludes: "*Sulphur Springs, New Zealand (Gunn.) (Type in Herb. Berk. Kew.)"*. Of numerous uncertainties we can be reasonably sure this collection was provided by Ronald Gunn from Tasmania. So, a key question is where did the annotation "New Zealand" originate in Massee's article? It is not written on the collection sheet. Was it an assumption that "*Sulphur Springs"* referred to a site near Rotorua, New Zealand given the well-known local volcanic activity? However, there is no location specifically called Sulphur Springs near Rotorua. There is a Sulphur Point but no Sulphur Springs. Or perhaps it was intended to refer to a sulphur spring rather than a place-name. Even more confusingly there is a place called Sulphur Springs in Texas, USA, and collections from that region were also examined by Massee in his article and numbered close to #257. It should be noted that Massee also refers to "*Gunn.*" with a full stop, implying an abbreviation, but of course it is not abbreviated. To me this all suggests some laxity in transcribing annotation on the part of George Massee. Of course, the annotation "New Zealand" may indeed be part of Gunn's original notes and not transcribed onto the collection sheet. That is a possibility, but we do not have Gunn's notes and I can find nothing in the transcribed correspondence between Hooker and his contacts (Kew website, 2020). Gunn certainly sent large numbers of Tasmanian collections to Hooker, but at that time he had not visited New Zealand, so an origin for the collection in New Zealand is very unlikely. On the other hand, we also know there is no Sulphur Springs in Tasmania, so where did that annotation on the collection sheet come from? Another slip by Massee? I believe we must retreat to the strongest evidence suggesting this collection was from Tasmania, collected by Gunn, and we should ignore everything else. That seems to have been the position adopted by M.C. Cooke in his Handbook of Australian Fungi (1895) who simply says "*S. gunnii, on the ground, Tasmania*". By the time Cunningham was writing about the species in 1944 it had acquired the distribution of "*Type locality: Rotorua, New Zealand and also Hobart, Tasmania"* [later Rodway collections]. But I believe this statement just propagates and expands the original confusion introduced by Massee.

From a photograph of the type collection of *Secotium gunnii* (blown up a bit) the fruitbody is clearly a secotioid fungus, and it was described by Massee as such, with small spores 7 x 4um. In my opinion *Secotium gunnii* represents a *Setchelliogaster*, present in Tasmania, collected by Ronald Gunn, and not represented in New Zealand (so far). Horak's 1971 description of *Descolea gunnii* is not secotioid and has much larger spores 10-12 x 6-7 um. It clearly represents a different and undescribed New Zealand-specific species, which I now refer to as *Descolea gunnii* sensu Horak.

Descolea gunnii sensu Horak

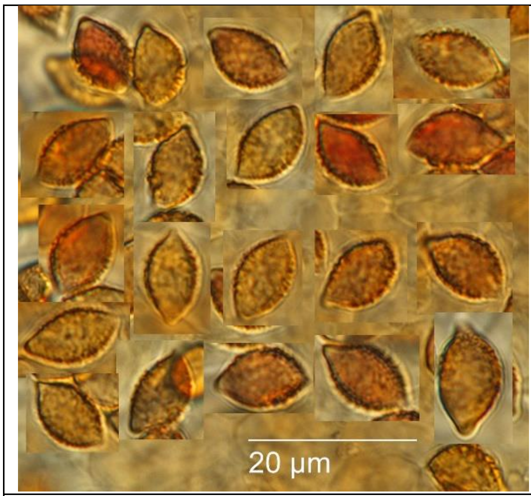
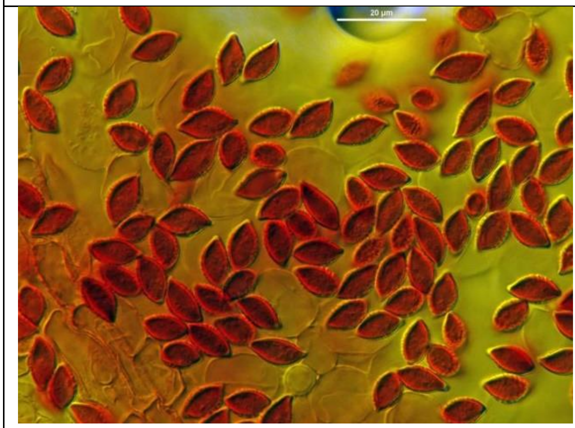
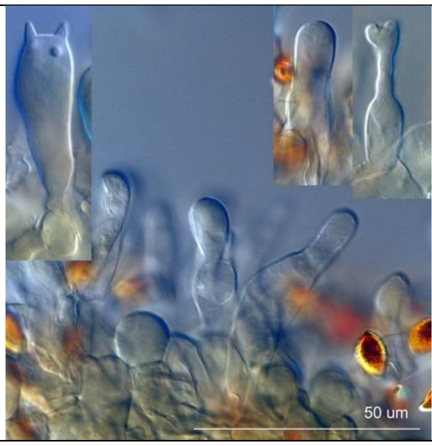
Having decided that *Descolea gunnii* sensu Horak is not the original version we are now faced with another issue. *D. gunnii* has been a name applied to all New Zealand *Descolea* species that are not slimy or wrinkled (the only three possibilities provided by Horak 1971). The sequence data now show that we have three species that are not slimy or wrinkled. Only one of them corresponds well with *D. gunnii sensu Horak* and it is not the most common of the three, by far. The most common species is related to (but not quite the same as) *Descolea recedens* originally described from Australia.

Here are some collections of the relatively uncommon *D. gunnii sensu Horak.*

PDD 88956: The collection was poorly gathered and without stem bases on 2 of the 3 fruitbodies. The single fruitbody with a stem base does not have the expected scales, but they may have worn off. Spore length=10.5-14.2µm (µ=12.0, σ=0.98), width=5.1-7.1µm (µ=6.0, σ=0.51), Q=1.7-2.3µm (µ=2.01, σ=0.16), n=25.

JAC15108: This collection does have the coarse scales at the stem base typical of the species. Spore length=9.5–13.1µm (µ=11.2, σ=0.78), width=5.8–7.7µm (µ=6.6, σ=0.46), Q=1.5–1.9µm (µ=1.69, σ=0.11), n=20

JAC15108	JAC15108
	
JAC15108	JAC15108

	
PDD 88956	PDD 88956
	

Descolea sp. 'Hinewai'

This is by far the most common species in New Zealand and usually misidentified as *D. gunnii* sensu Horak. It is phylogenetically close to the Australian *D. recedens*, but not the same species, as can be seen from the phylogeny (fig. 3) it is related to, but not the same as the Australian *D. recedens*. Any morphological differences require establishing and the taxon described as a new species. On the other hand, *D. gunnii sensu Horak* is much more uncommon and has distinct fibrous scales at the stipe base and is generally larger.

JAC13516: Spore length=10.4–13.4µm (µ=11.8, σ=0.67), width=6.8–8.0µm (µ=7.4, σ=0.28), Q=1.4–1.9µm (µ=1.60, σ=0.11), n=20

JAC8991	JAC9699

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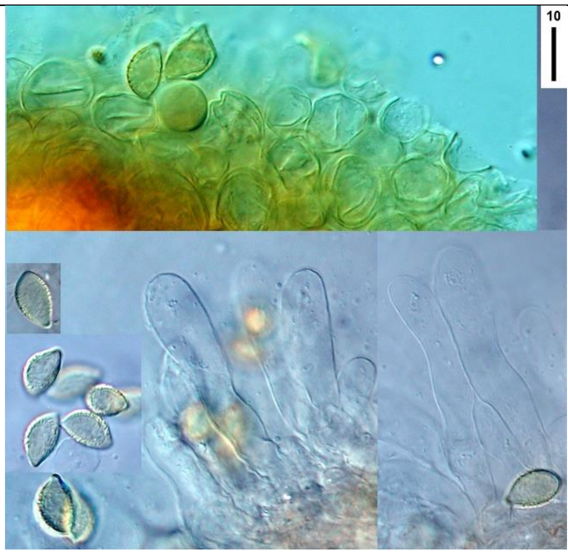
</td><td>
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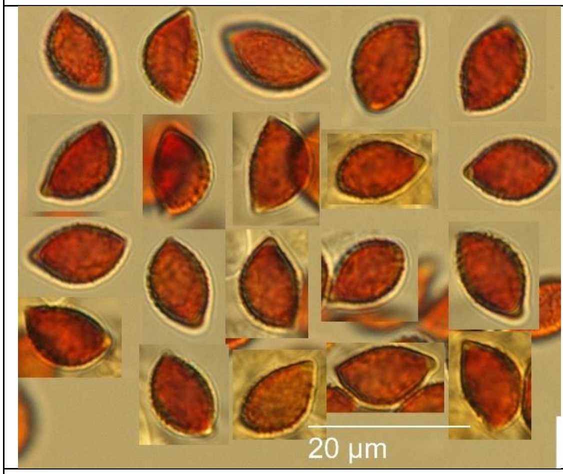	
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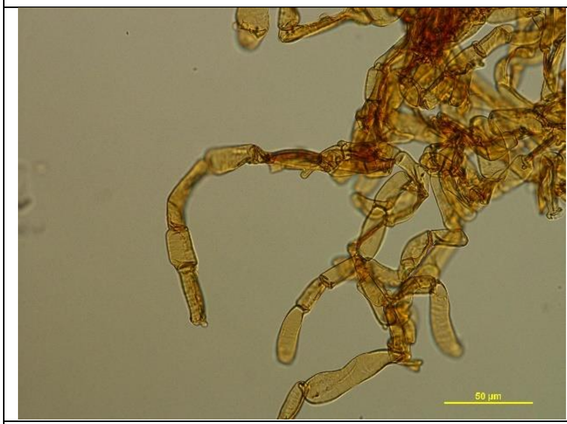
	
JAC13954	JAC15110 (Photo G. Smith)

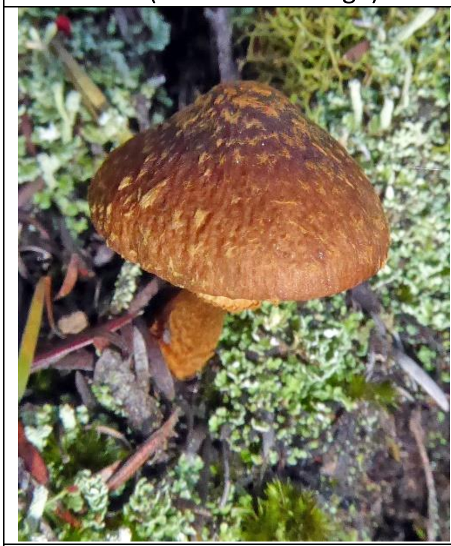
	

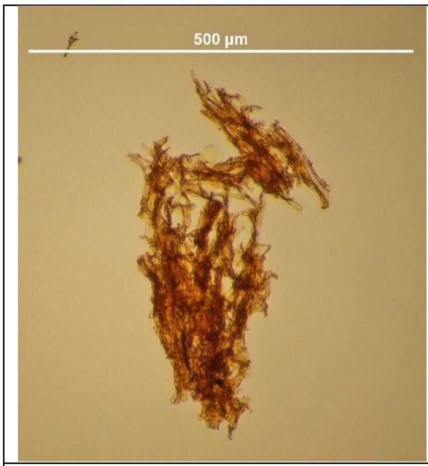
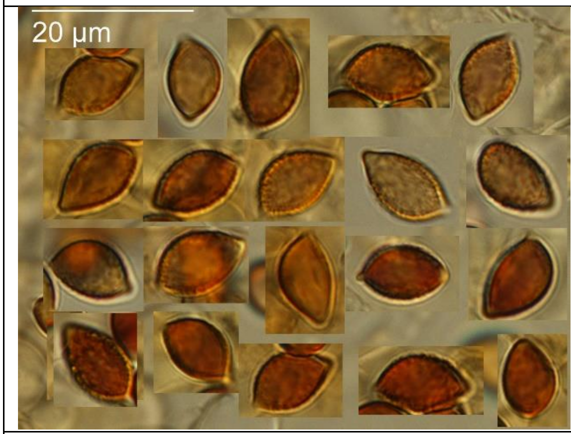
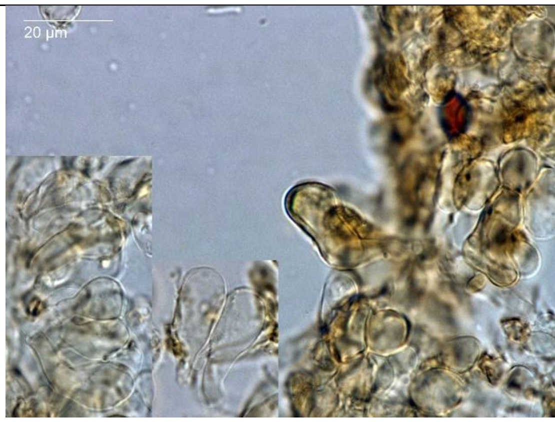
Descolea maculata

This species is less common than *D. sp. 'Hinewai'* but also misidentified as *D. gunnii*. *D. maculata* has veilar remnant at the base of the stipe that look like coarse fibres but consist of finer agglomerated veil fibres. This feature makes it much closer in appearance to *D. gunnii sensu Horak* than *D. sp. 'Hinewai'*. The spores are much less verrucose than either *D. sp. 'Hinewai'ff.* or *D. gunnii sensu Horak*, and often some will appear smooth. The cheilocystidia seem to form an agglutinated band on the gill edge, along with yellow material (in Melzers) and are hard to discern, but generally relatively broad rather than cylindrical. In this respect it differs from the description of the Western Australian original but sequence data indicate they are the same species.

JAC14614: with scales at base. Spore length=10.6–12.9µm (µ=11.8, σ=0.62), width=5.7–7.2µm (µ=6.4, σ=0.44), Q=1.7–2.0µm (µ=1.85, σ=0.11), n=14.

JAC15111: spore length=9.9–13.2µm (µ=11.4, σ=0.75), width=6.5–7.7µm (µ=7.1, σ=0.32), Q=1.5–1.9µm (µ=1.62, σ=0.12), n=20. Cheilocystidia difficult to discern without a squash.

JAC 14614 (Photo P. de Lange)	JAC 14614 (Photo P. de Lange)
	
JAC 14614 – stipe base fibrous scales	

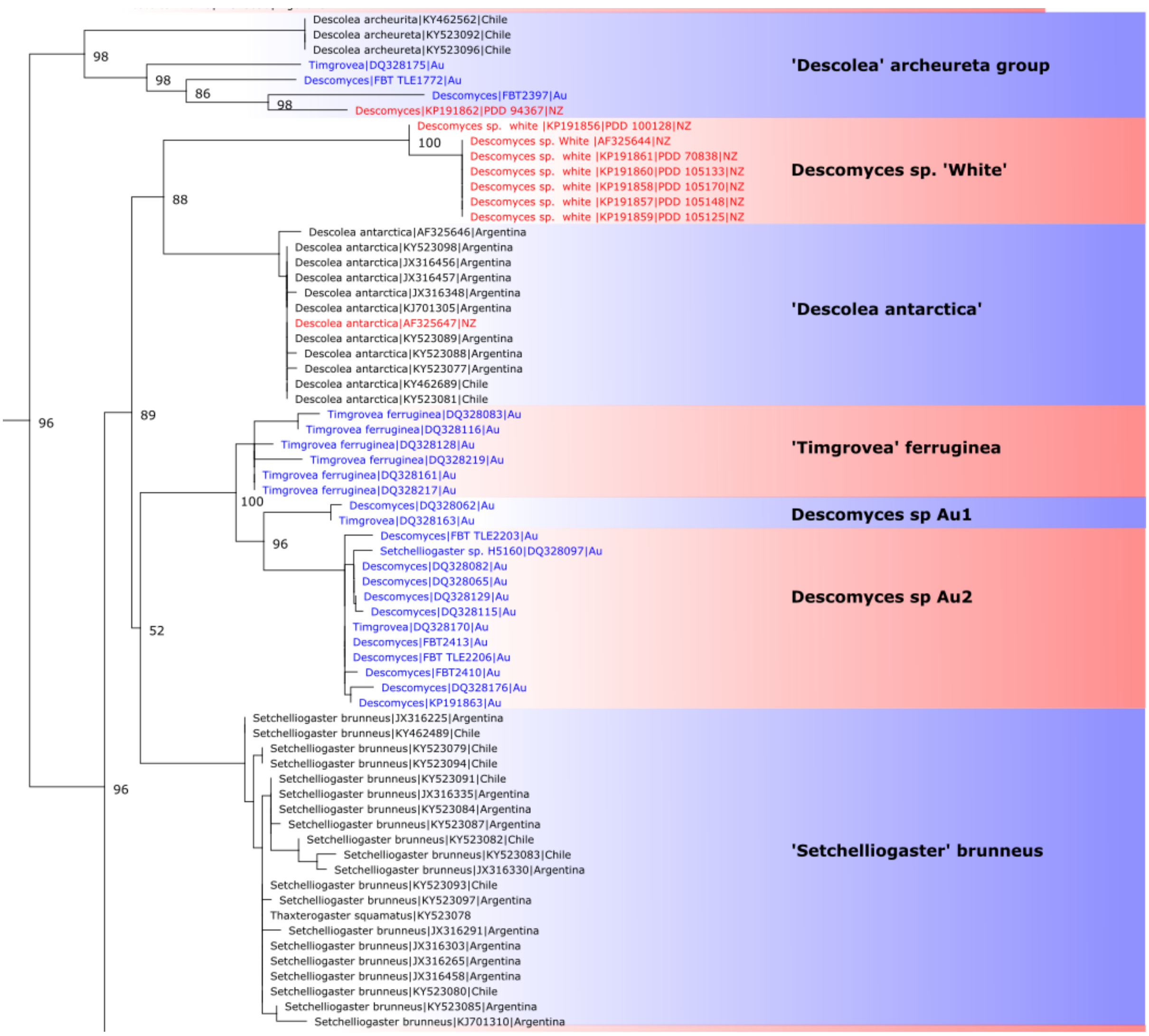
	
JAC15112 (Photo G. Smith)	JAC15112 (Photo G. Smith)
	
JAC15112	JAC15112
	
JAC15111 (Phoo N. Siegel)	
	

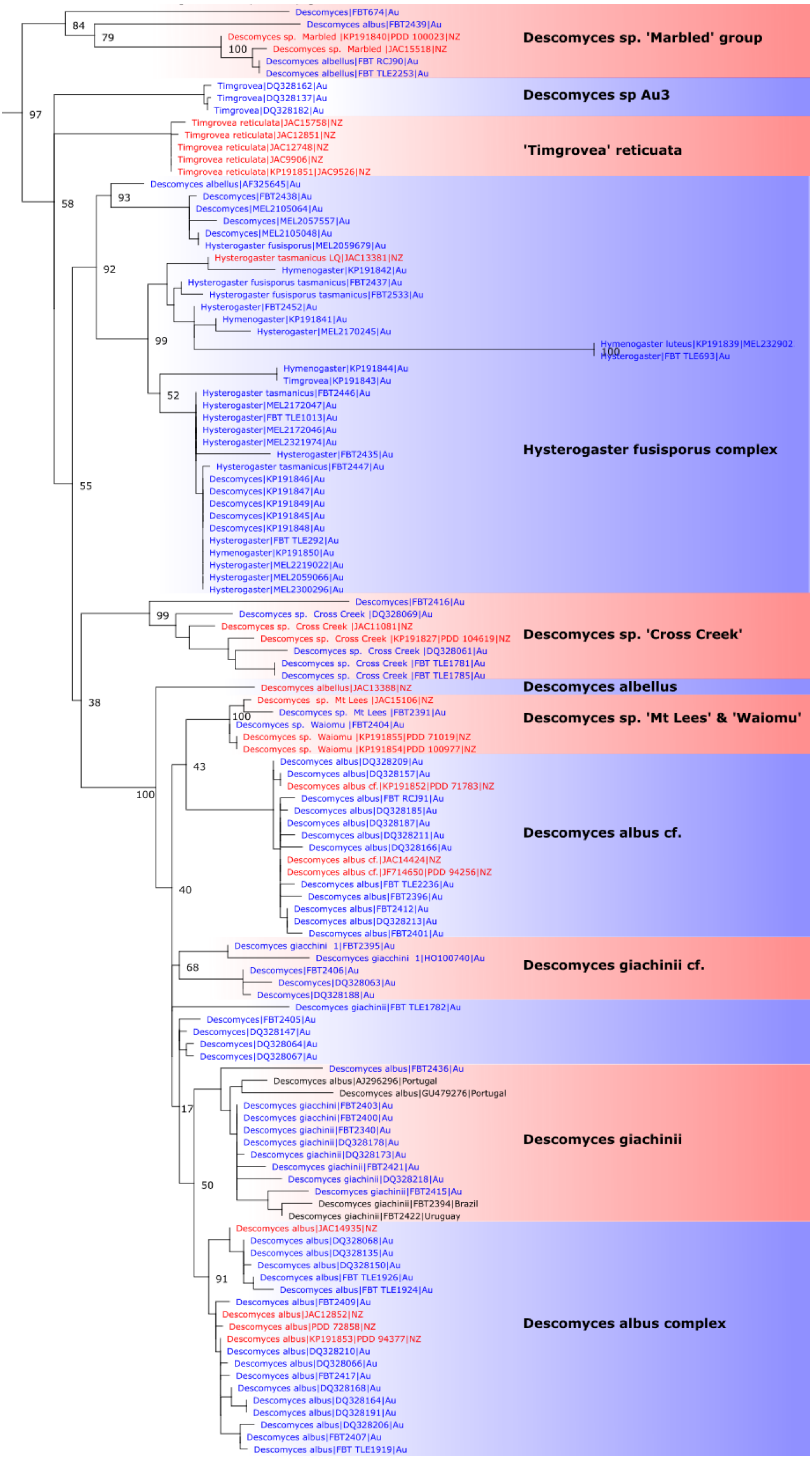
Descomyces

The commonly identified species in the genus *Descomyces* have been *D. albus* and to a lesser extent *D. albellus*. *D. albus* is a name used widely for these truffle-like species associated with introduced *Eucalyptus* around the world. *D. albus* was originally named for material from Glasgow, UK, and *D. albellus*, more sensibly, from Australia. Subsequently more species were added creating a total of eight described species, and all associated with Eucalypts, Australian Fabaceae, or Nothofagaceae. However, current sequence data indicate the eight named species are just the tip of an iceberg and many undescribed species remain. Meanwhile the characters originally used to identify species like *D. albus*, and even some of the similar genera (e.g., *Timgrovea*) no longer adequately separate collections/taxa. The commonly used names *D. albus* and *D. albellus* have been applied to multiple taxa and there is no easy way to resolve the correct usage.

Here I present the eleven New Zealand taxa apparent in the sequence data, with a marginal attempt at providing separating characters. Much more work is required before any of these could be named formally. A substantial amount of the sequence data and some photography was generated by Teresa Lebel during her 'Ross Beever fellowship' tenure at Manaaki Whenua, and based on the substantial collections of the late Ross Beever. Additional recent Australian data has been generated as part of a very informative barcoding project led by Teresa at the Royal Botanic Garden Melbourne.

Figure 5: ML *Descomyces*




Descomyces|FBT674|Au
Descomyces albus|FBT2439|Au
Descomyces sp. Marbled |KP191840|PDD 100023|NZ
Descomyces sp. Marbled |JAC15518|NZ
Descomyces albellus|FBT RCJ90|Au
Descomyces albellus|FBT TLE2253|Au
Descomyces sp. 'Marbled' group
Timgrovea|DQ328162|Au
Timgrovea|DQ328137|Au
Timgrovea|DQ328182|Au
Descomyces sp Au3
Timgrovea reticulata|JAC15758|NZ
Timgrovea reticulata|JAC12851|NZ
Timgrovea reticulata|JAC12748|NZ
Timgrovea reticulata|JAC9906|NZ
Timgrovea reticulata|KP191851|JAC9526|NZ
'Timgrovea' reticuata
Descomyces albellus|AF325645|Au
Descomyces|FBT2438|Au
Descomyces|MEL2105064|Au
Descomyces|MEL2057557|Au
Descomyces|MEL2105048|Au
Hysterogaster fusisporus|MEL2059679|Au
Hysterogaster tasmanicus LQ|JAC13381|NZ
Hymenogaster|KP191842|Au
Hysterogaster fusisporus tasmanicus|FBT2437|Au
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Hysterogaster|FBT2452|Au
Hymenogaster|KP191841|Au
Hysterogaster|MEL2170245|Au
Hymenogaster luteus|KP191839|MEL232902
Hysterogaster|FBT TLE693|Au
Hymenogaster|KP191844|Au
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Hysterogaster|MEL2300296|Au
Hysterogaster fusisporus complex
Descomyces|FBT2416|Au
Descomyces sp. Cross Creek |DQ328069|Au
Descomyces sp. Cross Creek |JAC11081|NZ
Descomyces sp. Cross Creek |KP191827|PDD 104619|NZ
Descomyces sp. Cross Creek |DQ328061|Au
Descomyces sp. Cross Creek |FBT TLE1781|Au
Descomyces sp. Cross Creek |FBT TLE1785|Au
Descomyces sp. 'Cross Creek'
Descomyces albellus|JAC13388|NZ
Descomyces albellus
Descomyces sp. Mt Lees |JAC15106|NZ
Descomyces sp. Mt Lees |FBT2391|Au
Descomyces sp. Waiomu |FBT2404|Au
Descomyces sp. Waiomu |KP191855|PDD 71019|NZ
Descomyces sp. Waiomu |KP191854|PDD 100977|NZ
Descomyces sp. 'Mt Lees' & 'Waiomu'
Descomyces albus|DQ328209|Au
Descomyces albus|DQ328157|Au
Descomyces albus cf.|KP191852|PDD 71783|NZ
Descomyces albus|FBT RCJ91|Au
Descomyces albus|DQ328185|Au
Descomyces albus|DQ328187|Au
Descomyces albus|DQ328211|Au
Descomyces albus|DQ328166|Au
Descomyces albus cf.|JAC14424|NZ
Descomyces albus cf.|JF714650|PDD 94256|NZ
Descomyces albus|FBT TLE2236|Au
Descomyces albus|FBT2396|Au
Descomyces albus|FBT2412|Au
Descomyces albus|DQ328213|Au
Descomyces albus|FBT2401|Au
Descomyces albus cf.
Descomyces giacchini 1|FBT2395|Au
Descomyces giacchini 1|HO100740|Au
Descomyces|FBT2406|Au
Descomyces|DQ328063|Au
Descomyces|DQ328188|Au
Descomyces giachinii cf.
Descomyces giachinii|FBT TLE1782|Au
Descomyces|FBT2405|Au
Descomyces|DQ328147|Au
Descomyces|DQ328064|Au
Descomyces|DQ328067|Au
Descomyces albus|FBT2436|Au
Descomyces albus|AJ296296|Portugal
Descomyces albus|GU479276|Portugal
Descomyces giacchini|FBT2403|Au
Descomyces giacchini|FBT2400|Au
Descomyces giachinii|FBT2340|Au
Descomyces giachinii|DQ328178|Au
Descomyces giachinii|DQ328173|Au
Descomyces giachinii|FBT2421|Au
Descomyces giachinii|DQ328218|Au
Descomyces giachinii|FBT2415|Au
Descomyces giachinii|FBT2394|Brazil
Descomyces giachinii|FBT2422|Uruguay
Descomyces giachinii
Descomyces albus|JAC14935|NZ
Descomyces albus|DQ328068|Au
Descomyces albus|DQ328135|Au
Descomyces albus|DQ328150|Au
Descomyces albus|FBT TLE1926|Au
Descomyces albus|FBT TLE1924|Au
Descomyces albus|FBT2409|Au
Descomyces albus|JAC12852|NZ
Descomyces albus|PDD 72858|NZ
Descomyces albus|KP191853|PDD 94377|NZ
Descomyces albus|DQ328210|Au
Descomyces albus|DQ328066|Au
Descomyces albus|FBT2417|Au
Descomyces albus|DQ328168|Au
Descomyces albus|DQ328164|Au
Descomyces albus|DQ328191|Au
Descomyces albus|DQ328206|Au
Descomyces albus|FBT2407|Au
Descomyces albus|FBT TLE1919|Au
Descomyces albus complex

Key to New Zealand species of *Descomyces* sensu lato (*Hysterogaster*) – excluding PDD 94367 and *Descolea antarctica*

1	Frbs always with small basal pad/stipe, with nothofagaceae and myrtaceae. Spores < 14um	*Descomyces sp. ‘white’*
1’	Frbs without basal pad, with myrtaceae, spores > 14um.	2
2	Spores hyaline, dextrinoid, thick-walled, smooth, without perisporium, with myrtaceae	*Hysterogaster fusisporus/tasmanicus group*
2	Spores pigmented, with perisporium and/or reticulate/verrucose	3
3	Frb background colour white, usually with golden tomentum	4
3	Frb background colour golden/tan	8
4	at least some spores very coarsely reticulate in mature frbs	*Timgrovea reticulata*
4	Spores verrucose, wrinkled, reticulate but not grossly so	5
5	Spores with wrinkled epispore	6
5	Spores verrucose, no reticulation	*Descomyces ‘albus’*
6	Gleba maturing unequally, contrasting patches	*Descomyces sp. ‘Marbled’*
6	Gleba maturing equally	7
7	Spore Q < 2.0. L < 17um	9
7	Spore Q > 2.0 L > 17um	Sp. 8 ‘albus-like’
8	Epispore poorly developed, with native myrtaceae	*Descomyces sp. 'Cross Creek’*
8	Epispore well developed, with Eucalyptus	*Descomyces albellus*
9	Spore Q > 1.7	Sp. 7
9	Spores Q < 1.7	Sp. 11

Descolea archeureta group

With myrtaceae.

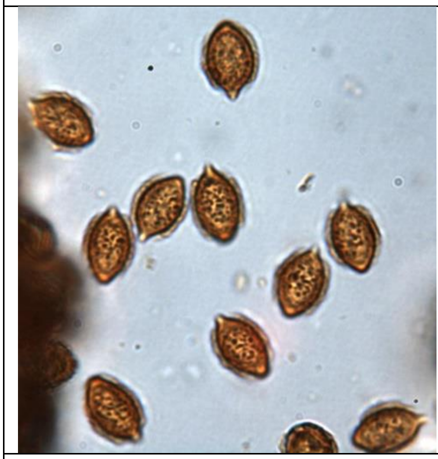
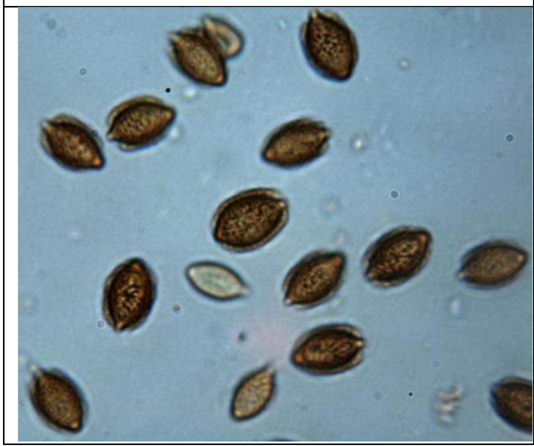
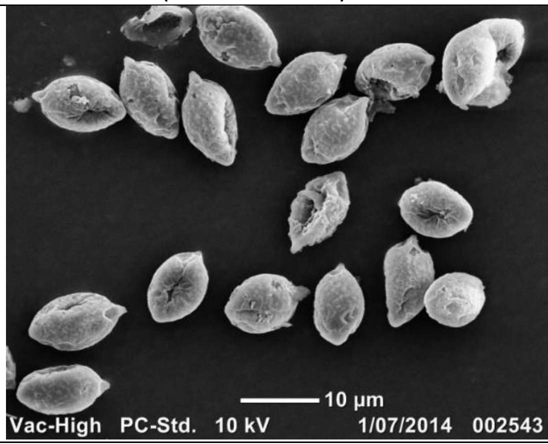
PDD 94367, sequenced, but with no accompanying notes, falls within this group. *D. archeureta* is a purlpish brown *Thaxterogaster*-like species.

Descomyces sp. ‘White’

With Nothofagaceae and Myrtaceae.

Distributed Canterbury to Nelson, white peridium, small stipe-like basal pad.

PDD 100128	PDD 100128

	
PDD 100128	PDD 105125 (Photo T. Lebel)
	
PDD 70838	PDD 105133 (Photo T. Lebel)
	

Descolea antarctica

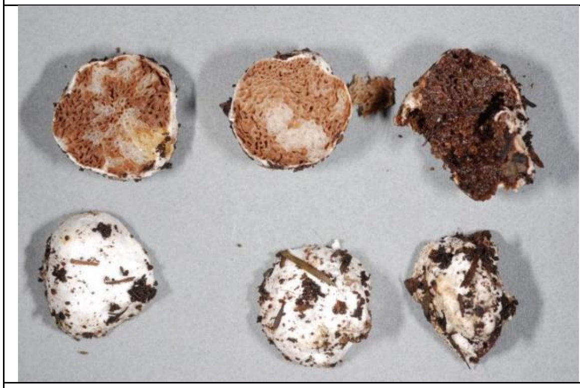
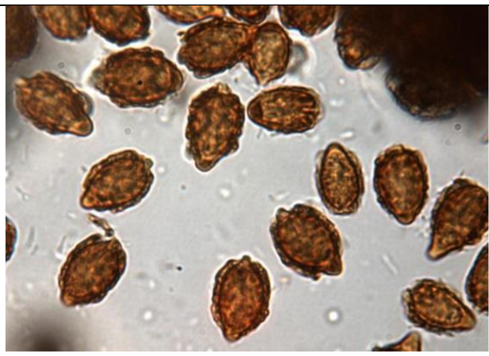
Horak NZ5182. No further notes unfortunately.

Descomyces sp. 'Marbled'

With Myrtaceae. This species clusters with Australian material labelled *D. albus* but I think the identification requires re-evaluation.

PDD 100023: Most of the material shown in the accompanying photographs is not present in the packet. Only half of a single fruitbody remains. It is in poor condition - attacked by mites? Note the unevenly maturing gleba shown in photos. Spore length=14.5-18.6µm (µ=16.6, σ=1.29), width=9.1-10.1µm (µ=9.7, σ=0.32), Q=1.5-1.9µm (µ=1.71, σ=0.11), n=10

JAC15518: With *Eucalyptus*

PDD 100023	PDD 100023
	
JAC15518 (Photo G. Smith)	JAC15518 (Photo G. Smith)
	

Descomyces sp. 'Cross Creek'

Au + New Zealand, with Myrtaceae

PDD 104619: not seen

JAC11081: Thick walled tan hyphae present on peridium. Only a few of the spores have wings.

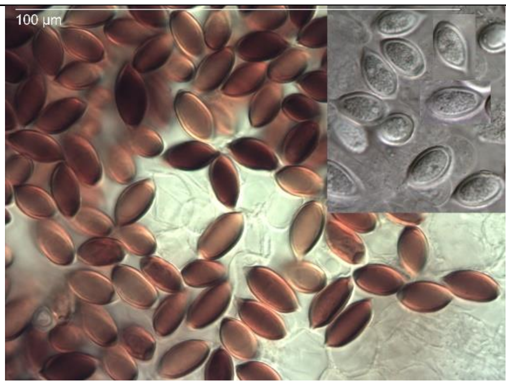
JAC11081	JAC11081
	

Hysterogaster tasmanicus/fusisporus group

with Myrtaceae

This species does not look like a typical *Descomyces*. It has fruitbodies bruising reddish and becoming brown and has hyaline/pale yellow smooth spores and they are strongly dextrinoid. I believe this material represents *Hysterogaster tasmanicus*, described from Australia, or at least a close relative. That agrees with a several recent sequenced collections from Australia also identified as *Hysterogaster* and including the type species of the genus *H. fusisporum*. It is the surprising position of this species that undermines the use of the name *Descolea* and all the other generic names used for these ectomycorrhizal species. The group also appears to contain material labelled *Hymenogaster luteus* but that is a European species.

JAC13381: all fruitbodies in picture have same dextrinoid spores. Cutis clamped, pale brown in KOH. Spores hyaline in KOH, thick walled. Peridium not hymeniderm and no columella. Spores 13-16 x 7-8.

JAC13381	**JAC13381**
	

Timgrovea reticulata

This is the type species of the genus *Timgrovea* and originally described from South Australia. It is present in Australia and New Zealand with Myrtaceae. *Timgrovea* does not seem to be morphologically distinguished from *Descomyces*.

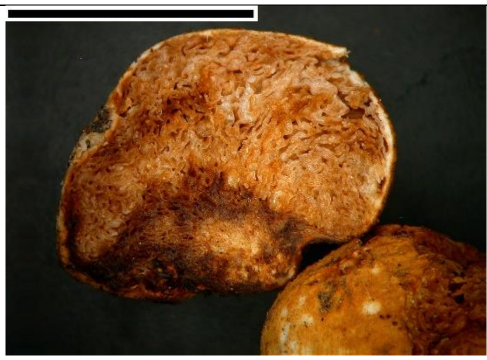
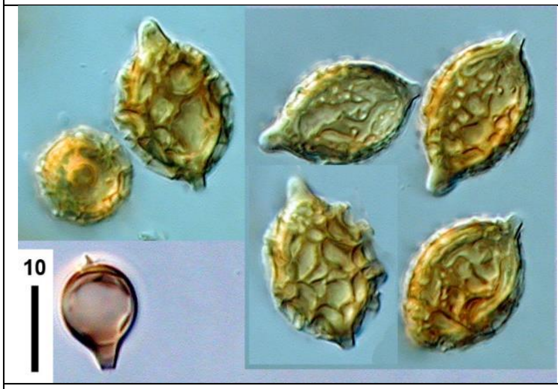
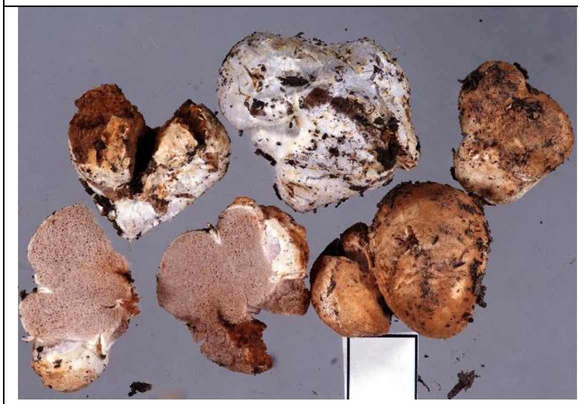
JAC12851: Peridium with yellow fibrils. The reticulate spore is not always present in this species. *T. macrosporus* has spores 18-24 x 12-17 and *T. reticulatus* 18-22 x 11-15. Cunningham distinguished the two based on *T. macrospora* having a thick endospore wall (2um thick and deeply coloured), and *T. reticulatus* with a thin endospore wall (1um thick). This collection has an endospore wall varying between 1 and 1.8um. On balance it fits *T. reticulatus* but equivalence with Australian material needs to be established.

JAC9906: Spores incompletely reticulate, 2 spored and length=18.0–20.8µm (µ=19.7, σ=1.0), width=12.1–14.9µm (µ=12.9, σ=1.1), Q=1.3–1.7µm (µ=1.5, σ=0.2), n=6. Endospore wall 2um thick.

JAC9526: Spores 15 x 9um mucronate, mainly 2-spored.

JAC12748: Surface with fine brown tomentum. Gleba appears macroscopically partly gelatinised. Gleba and peridium no reaction in KOH or FeSO4. No taste. Parts of gleba yellowing on exposure.

JAC12851	JAC9906

	
JAC9906	JAC9526
	
JAC 12748	JAC12748
	

Descomyces sp. 'Mt Lees' & sp. 'Waiomu'
with Myrtaceae, Au & New Zealand

PDD 100977: peridium with golden tomentum, clamped. Spore length=15.3–21.1µm (µ=16.8, σ=1.38), width=8.0–10.4µm (µ=8.9, σ=0.58), Q=1.7–2.2µm (µ=1.89, σ=0.15), n=20

JAC15106: no micro details

PDD7 1019	PDD 71019

	
JAC15106 (Photo G. Smith)	JAC15106 (Photo G. Smith)
	

Descomyces albus cf.

This species is with both *Kunzea* and *Eucalyptus* in New Zealand

There are at least three sequenced taxa that have been labelled *D. albus* and the use needs narrowing down. To quote Castellano & Bougher (1993) … *"However, we conclude that Descomyces albus should be reserved for those collections in which a polycystoderm (epithelium or layered arrangement of inflated cells) can be recognised (FIG. 15), whereas D. albellus is applicable to those specimens having a predominantly hyphal inner peridium with few swollen end-cells (FIG. 16)."*

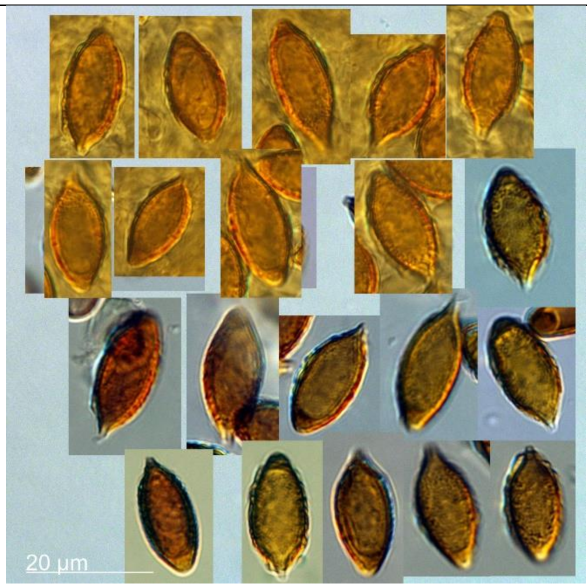
Both *D. albus cf.* and *D. albus* listed here have the polycystoderm elements in some (not all) collections, but the fruitbody colour and spore morphology indicate the species I've labelled *D. albus* is a better fit. Australian material under this name has not been examined.

The type of *D. albus* is from Glasgow, presumably with an introduced Eucalypt. The type of *D. albellus* is from Tasmania.

PDD 71783: Peridium covered in golden tomentum. Hyphae clamped. (1)2-spored. Spores dextrinoid. length=15.6-20.7µm (µ=18.8, σ=1.16), width=7.9-9.9µm (µ=9.0, σ=0.60), Q=1.9-2.6µm (µ=2.10, σ=0.17), n=20. Note that the fruitbodies in this collection are tiny, but the same taxon in collection PDD 94256 has considerably larger fruitbodies. Polycystoderm elements not observed.

PDD 94256: Peridium covered in golden tomentum. Spores length=19.7–28.8µm (µ=24.2, σ=2.08), width=9.6–13.5µm (µ=11.8, σ=0.91), Q=1.8–2.4µm (µ=2.06, σ=0.16), n=20. Polycystoderm elements observed.

JAC14424: Smell rubbery, scleroderma-like

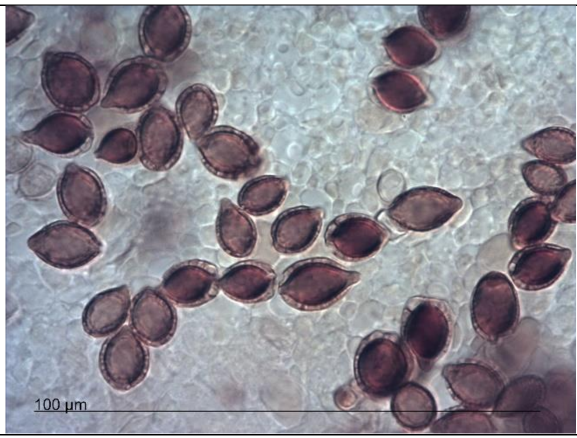
PDD 71783	PDD 71783
	
JAC14424	
	

Descomyces 'albellus'

with Myrtaceae (*Eucalyptus*)

Not this is not the same as Australian material labelled *D. albellus* (AF325645)

JAC13388: Peridium densely coated in golden thick-walled hairs (cf. *D. angustisporum*). Inner peridium with only scattered inflated cells. length=12.6–17.0µm (µ=14.9, σ=1.34), width=8.9–10.6µm (µ=9.6, σ=0.61), Q=1.4–1.7µm (µ=1.55, σ=0.11), n=10

JAC13388	JAC13388
	

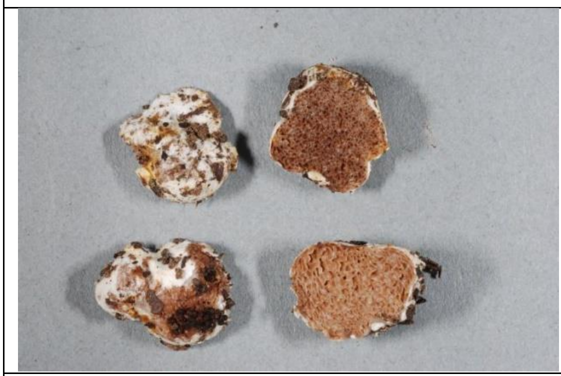
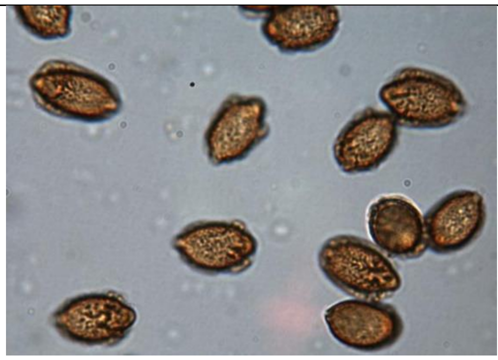
Descomyces 'albus' complex sp. 1

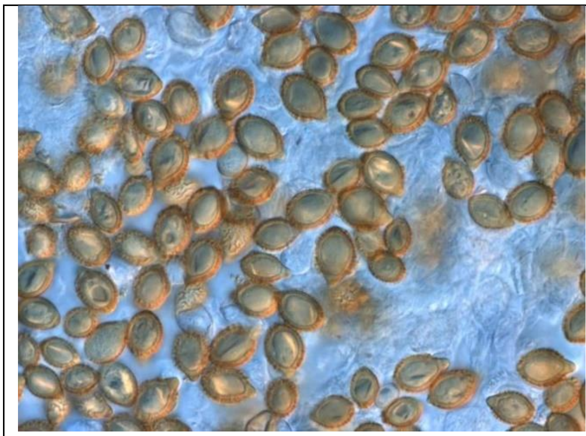
with Myrtaceae

JAC12852: With coarser plates than PDD 15851, different spores and peridium white and without yellow fibrils and fruitbody smaller. length=15.6–19.2µm (µ=17.6, σ=1.06), width=9.7–10.8µm (µ=10.2, σ=0.40), Q=1.5–1.9µm (µ=1.73, σ=0.11), n=13

PDD 72858: Collection consists of 1/2 of a fruitbody. Spores finely verrucose, length=14.5-15.7µm (µ=15.1, σ=0.36), width=8.5-10.5µm (µ=9.7, σ=0.49), Q=1.5-1.7µm (µ=1.57, σ=0.08), n=11

PDD 94377: Spore length=15.3–18.9µm (µ=16.9, σ=1.08), width=9.7–11.6µm (µ=10.4, σ=0.63), Q=1.5–1.9µm (µ=1.63, σ=0.13), n=12

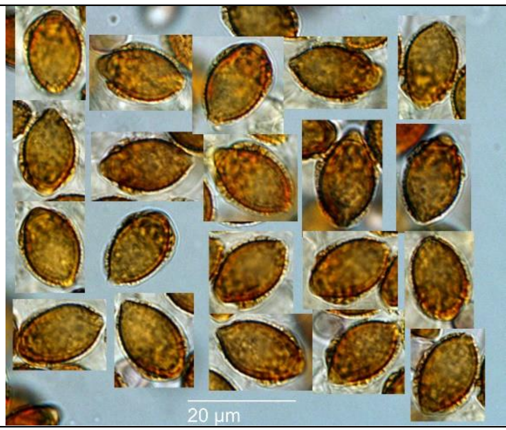
PDD 94377	PDD 94377
	
PDD 72858	JAC12852

Descomyces ‘albus’ complex sp. 2

New Zealand with Myrtaceae

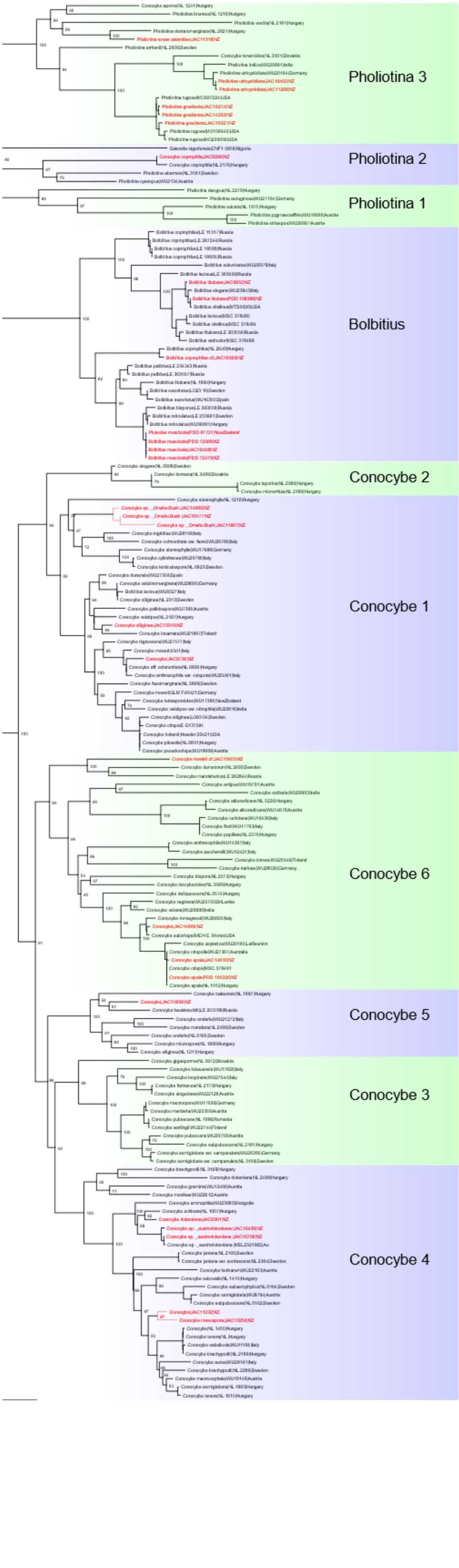
JAC14935: [GS] Growing in soil beneath tea-tree. Up to 18 mm in diameter. [JAC] Sequence says D. albus clade. Subpellis not a polycystoderm. 2-spored. Possible with cylindrical cystidia? Spores length=15.2–18.4µm (µ=16.6, σ=0.80), width=9.6–11.2µm (µ=10.2, σ=0.49), Q=1.5–1.8µm (µ=1.63, σ=0.09), n=20

JAC14935 (Photo G. Smith)	JAC14935 (Photo G. Smith)
	
JAC14935 (Photo G. Smith)	JAC14935
	

Saprophytic species

Conocybe, *Pholiotina* and *Bolbitius* are the remaining traditional genera of New Zealand representatives of the family Bolbitiaceae. In New Zealand the species are encountered infrequently, and often occur singly or with a small number of fruitbodies. They have been poorly studied for that reason. The taxa identified by Watling and Taylor in their 1983 work are quite difficult to match with more recent collections and some of my assignments may be incorrect. In addition, the original collections on which that work is based, are often sparse, fragmentary, in poor condition and difficult to interpret. It is quite likely that many more New Zealand species remain to be recorded. Fig. 6 shows the current phylogenetic outline of the group including samples New Zealand species.

Figure 6: Major clades of *Pholiotina*, *Conocybe* and *Bolbitius* with numbering based on Toth (2013) (ITS + LSU + Tef). New Zealand sequences in red. Bootstrap support from 1,000 replicates



Pholiotina was traditionally separated from *Conocybe* using the distinction …

Conocybe - cheilocystidia lecythiform, < 30um long. Stem usually without ring.
Pholiotina - cheilocystidia not lecythiform or > 30um long. Stem usually with ring.

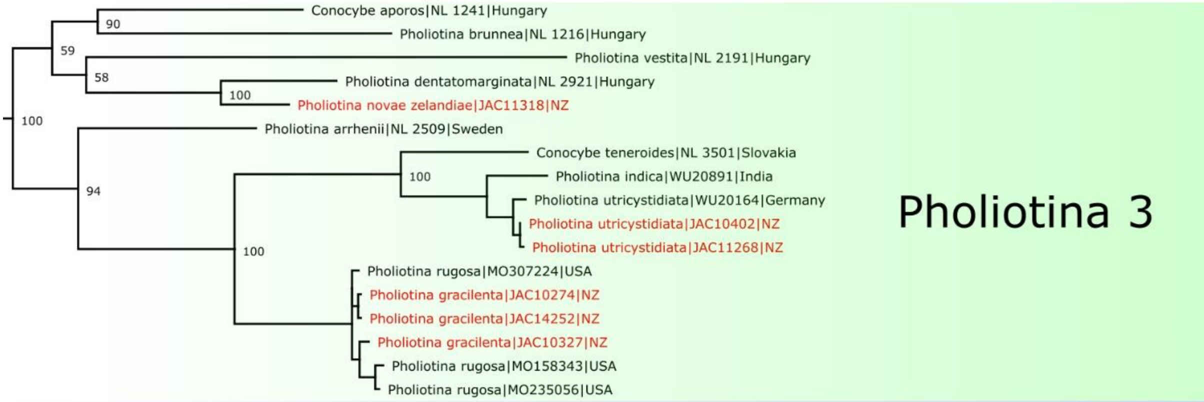
The phylogenetic data (Toth 2013, Fig. 6.) show that *Pholiotina*, as defined above*,* is paraphyletic. The traditional ringed species, like *P. rugosa*, all belong in *Pholiotina* 3, which represents *Pholiotina* sensu stricto. New generic names are required for *Pholiotina* 2 (the coprophila group), and *Pholiotina* 1 (the sulcata group). The phylogeny suggests *Pholiotina* 1 could be folded into *Bolbitius* but I do not know if morphology supports that suggestion. The genus *Galerella* (based on *G. plicatella*) is paraphyletic and the phylogenetic position of the type species remains unknown. In addition, the traditional *Conocybe* sub-generic classification based on the types of stipe cystidia/hairs (sections Conocybe, Pilosellae, Mixtae) is also not supported by the phylogenetic data. Other characters must be sought to achieve a more natural separation of groups within these genera. We don't yet have enough information on the New Zealand taxa to establish robust morphological species boundaries and the key presented here is preliminary, and may not work effectively, especially because there are, no doubt, many New Zealand taxa not included.

Key to the known New Zealand saprophytic species in the Bolbitiaceae

1	On dung	2
1	Not on dung	4
2	Fruitbodies coprinoid/leucocoprinus-like	*B. coprophila cf.*
2	Fruitbodies not coprinoid/leucocoprinus-like	3
3	Cheilocystidia lageniform	*P. coprophila*
3	Cheilocystidia lecythiform	*C. pubescens*
4	At least some cheilocystidia lecythiform	7
4	Cheilocystidia entirely cylindrical/lageniform/utriform. Stipe often with a ring.	5 (*Pholiotina*)
5	Cheilocystidia utriform. Urban gardens	*P. utricystidiata*
5	Cheilocystidia lageniform, narrowing towards apex	6
6	Veilar fragments on the stem, but no ring	*P. novaezelandiae*
6	No veilar fragments on the stem. Usually with pronounced ring but sometimes lost.	*P. gracilenta*
7	Cap pale – white to pale cream when fresh (but see siligna/JAC9736)	8
7	Cap with darker brown colours, at least in cap centre	9
8	In lawns, spores > 12um long, Q > 1.4	*C. apala*
8	In native bush, spores < 12um long, Q < 1.4	*C. sp. JAC14809*
9	Spores minutely ornamented	*C. horakii*
9	Spores smooth	10
10	Spores without germ pore or callus	*C. pilosella*
10	Spores with distinct germ pore	11
11	In urban lawns. Cheilo and caulocystidia purely lecythiform.	*C. 'austrorickeniana'*
11	In native bush or pasture.	12
12	Spores > 12um long, 2-3 spored, caps pale tan contrasting orange gills	13
12	Spores < 11um long, caps darker tan/brown	14
13	Caulocystidia > 20um long. Caps pale	*C. silignea aff.*
13	Caulocystidia < 15um long. Caps tan	*C. JAC9736*

14	Spores > 9um, gills tan, in pastures, stipe base swollen and rooted, caulocystidia purely lecythiform.	*C. echinata aff.*
14	Spores < 9um, gills brighter, in bush, caulocystidia not purely lecythiform – mixed or hair-like.	14
15	Cap with red-brown tones when fresh. 2 & 4 spored versions (with different spore sizes). No lecythiform caulocystidia.	*C. sp. 'Oamhu'*
15	Cap without reddish brown tones. 4-spored. At least some lecythiform caulocystidia.	*C. mesospora*

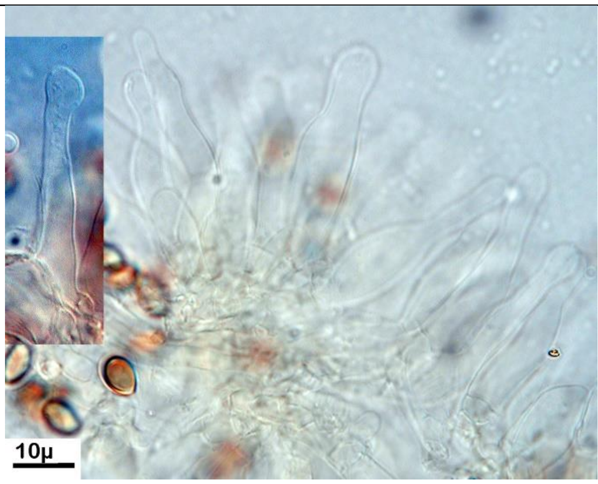
Pholiotina 3 (*Pholiotina* sensu stricto)

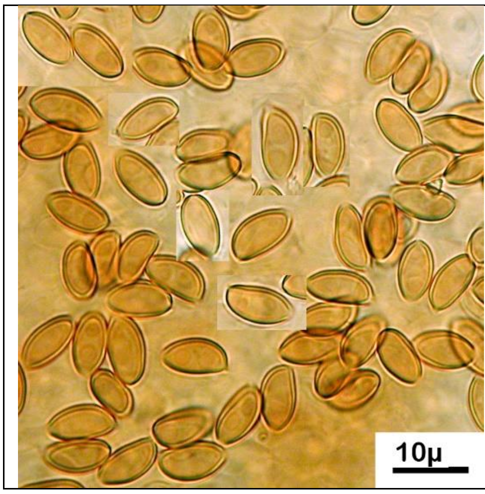


Pholiotina novaezelandiae

P. novaezelandiae was originally described from a sheep paddock. The material shown here came from a mossy log in native forest. However, I believe there is enough similarity in the features to suggest this is Watling & Taylor's species.

JAC11318: No ring but with a veil remaining as fragments on the stem. Spores length=8.1–10.1µm (µ=9.1, σ=0.5), width=4.4–5.2µm (µ=4.8, σ=0.3), Q=1.7–2.1µm (µ=1.9, σ=0.1), n=13.

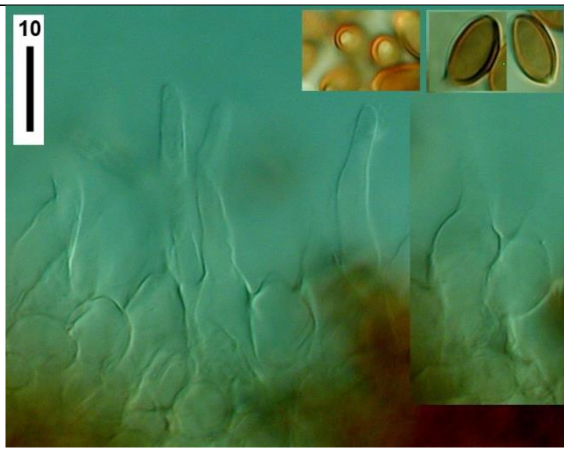
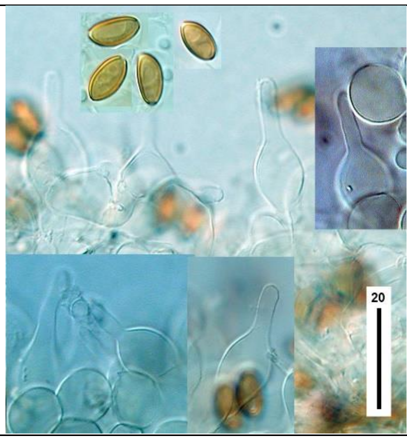
JAC11318	JAC11318
	
JAC11318	

Pholiotina gracilenta

The phylogenetic data suggest the New Zealand species is so close to the widespread *P. rugosa* that it should be regarded as a synonym. The presence/prominence of the ring is variable.

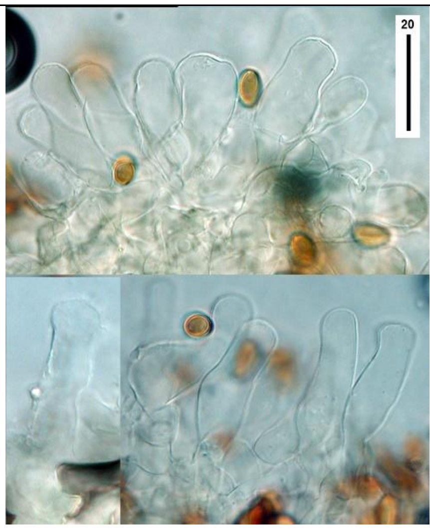
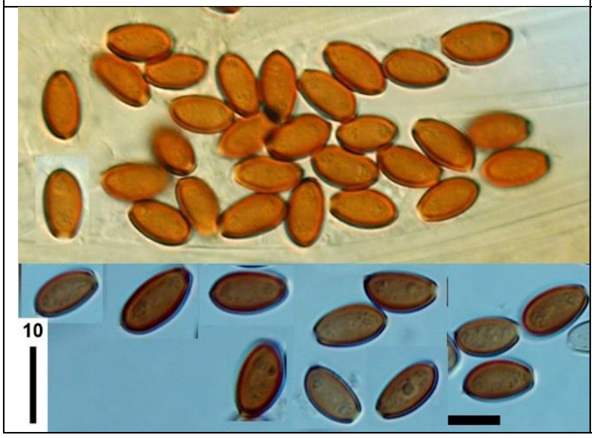
JAC10274: Spores 9-11 x 4um

JAC 10274	JAC 10274
	
JAC10327	JAC10327
	

Pholiotina utricystidiata

Presumably this is an introduced species and found so far only in urban habitats.

JAC 10402: Cap hygrophanous dark cinnamon when wet drying to 'G' 5mm to 4cm. Gills milky coffee. Stem 4mm diam to 4cm long, white fibrous, bruising brown, without bulb, caulocystidia at apex. Ring mobile, thick, boot-like, ridged on upper surface. Fasciculate. Taste and smell strongly mealy. Not volvate. All basidia studied are 4-spored (not *P. teneroides*) spores 8.7-10.7(9.4) x 4.9-5.7(5.3) and pore 1.8um. Spores print rusty-tawny, with distinct germ pore. Cheilocystidia not lecythiform, broad utriform to 10x45um. Caulocystidia in fascicles, like cheilocystidia.

JAC 10402	JAC 10402
	
JAC 10402	JAC 11268
	

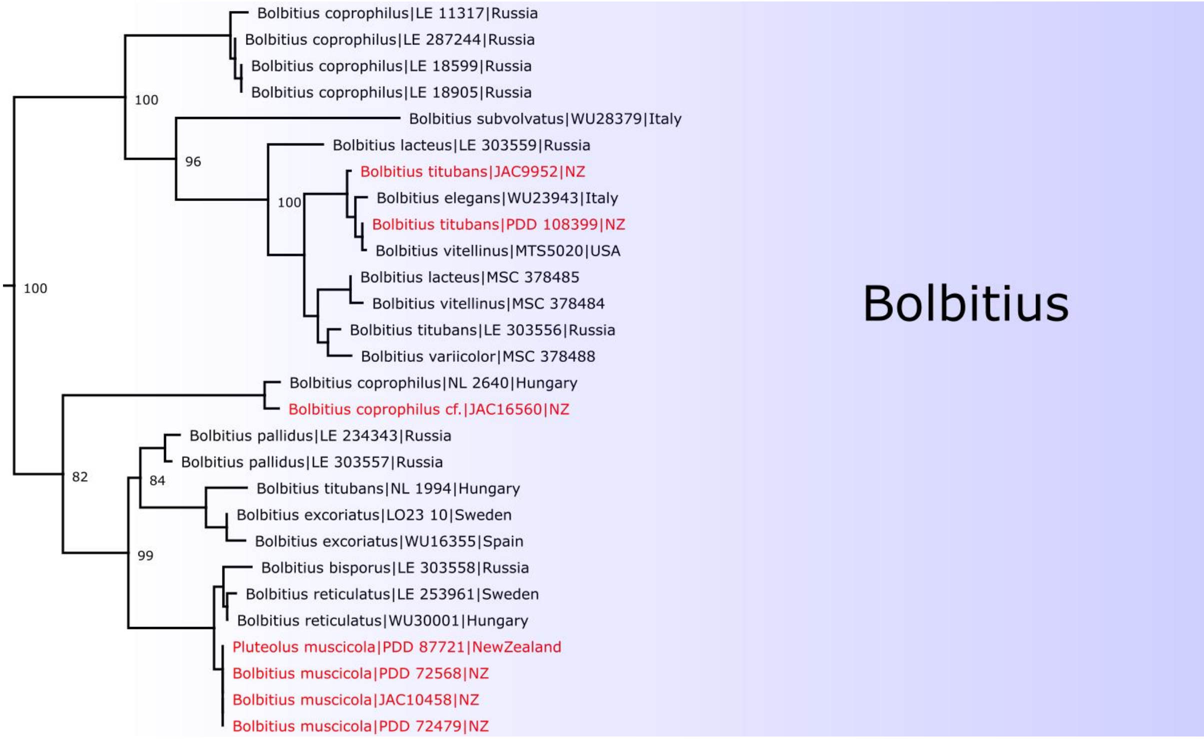
Pholiotina Clade 2 (the coprophila group)

Pholiotina coprophila

Pileus viscid and no veilar remnants, and on dung. A species conforming to *C. vinaceobrunnea* should also be sought on dung. It was recorded by Hausknecht as present in New Zealand after the original description from the Cook Islands.

JAC 9296	JAC 9296

Bolbitius



In addition to the two species listed here Watling & Taylor (1983) included two additional taxa, sp. 1 and sp. 2. It seems to me they can both be accommodated in what is now understood to be the highly variable species *B. titubans*.

Bolbitius titubans

This is a highly variable species known under several names including *B. vitellinus* and *B. titubans*. It is an introduction to New Zealand in modified habitats.

JAC 9952	JAC 9952

Bolbitius coprophila cf.

This very attractive dung inhabiting coprinoid-like species was recently photographed and collected by Christian Schwarz. The New Zealand material has a sequence identical to a deposited collection from Hungary (in Toth et al, 2013). However, I do not believe this represents the true *B. coprophila* and there are deposited sequences which lie elsewhere in the clade. The true *B. coprophila* is described with pinkish colours, which this does not have.

JAC16560 (Photo C. Schwarz)	JAC16560
	

Bolbitius muscicola

The closely related northern hemisphere *B. reticulatus* and our *B. muscicola* are similar in the sense that they do not look like typical *Bolbitius* species, and perhaps more like *Pluteus*, which led to them being placed in a separate genus *Pluteolus*.

JAC 10458	JAC 10458
	

Conocybe 1

There is a sequence labelled *C. tetrasporoides* (type from the USA) as coming from New Zealand (WU 17385) but there is no further data on this collection, no collections in New Zealand, and no other confirmatory sequences of this species. If present, it will be like the 2-spored version of 'Omahu' in spore size, but 4-spored.

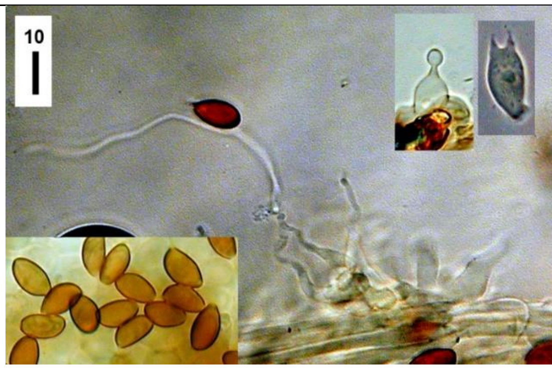
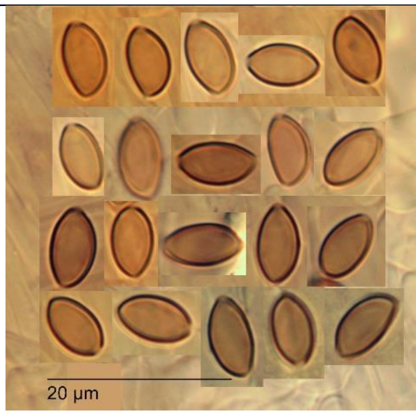
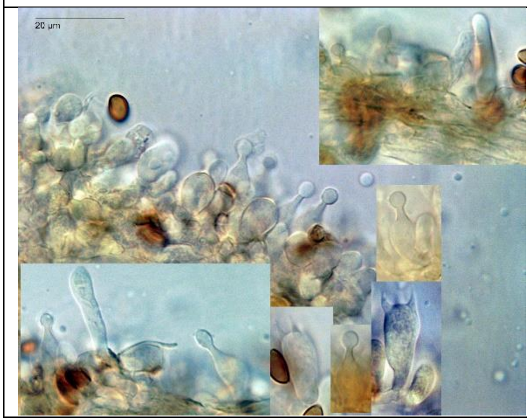
Conocybe sp. 'Omahu Bush (PDD 87267)'

Tradition section mixtae?

JAC10177: cheilocystidia lecythiform and gill edge covered with brown amorphous material, spores smooth, with germ pore, 2-spored (definitely - all basidia) spores length=10.2–12.6µm (µ=11.3, σ=0.60), width=5.9–6.9µm (µ=6.4, σ=0.29), Q=1.6–1.9µm (µ=1.77, σ=0.07), n=20. Pilocystidia not observed. Caulocystidia not lecythiform, a mixture of small irregular and large vermiform

JAC14680: 4-spored (definitely). No veil. Cheilocystidia a mixture of mainly lecythiform and a few pili cystidia, caulocystidia a mixture of long/short cystidia but no lecythiform seen. length=7.4–9.0µm (µ=8.1, σ=0.42), width=3.9–5.1µm (µ=4.5, σ=0.24), Q=1.7–2.0µm (µ=1.82, σ=0.10), n=20.

JAC 10177	JAC 10177

	
JAC 14680	
	
JAC 14680	
	

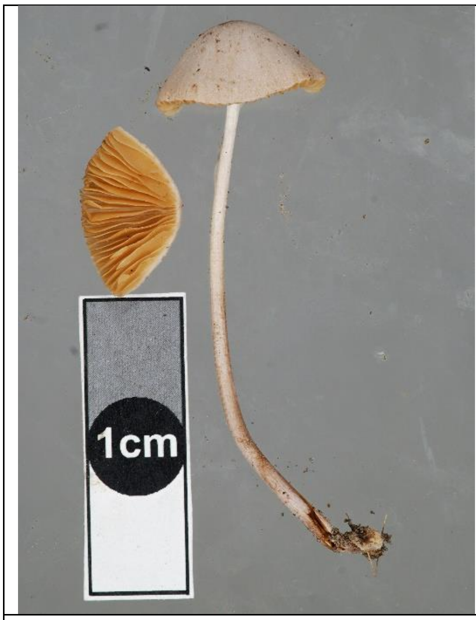
Conocybe silignea cf.

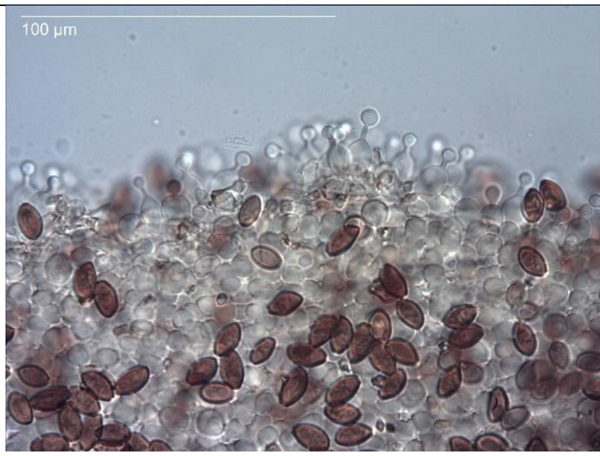
Traditiona section pilosellae

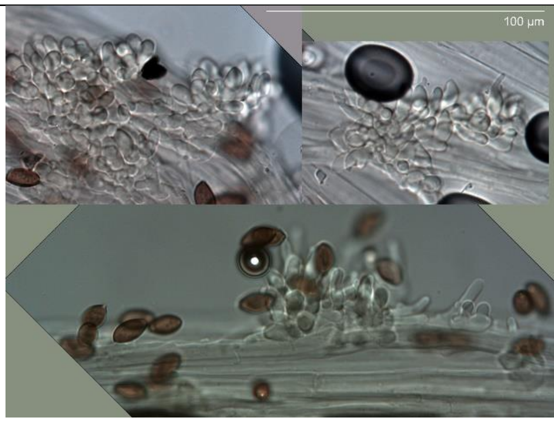
From a morphological perspective this seems close to the northern hemisphere *C. silign*ea but the sequence data do not support that. It is probably an undescribed indigenous species.

JAC13319: small basal bulb. Basidia mainly 2-spored but some 3. Caulocystidia irregular, non lecythiform. Cheilocystidia lecythiform. Pleurocystidia absent. Spores 13 x 7

JAC 13319	







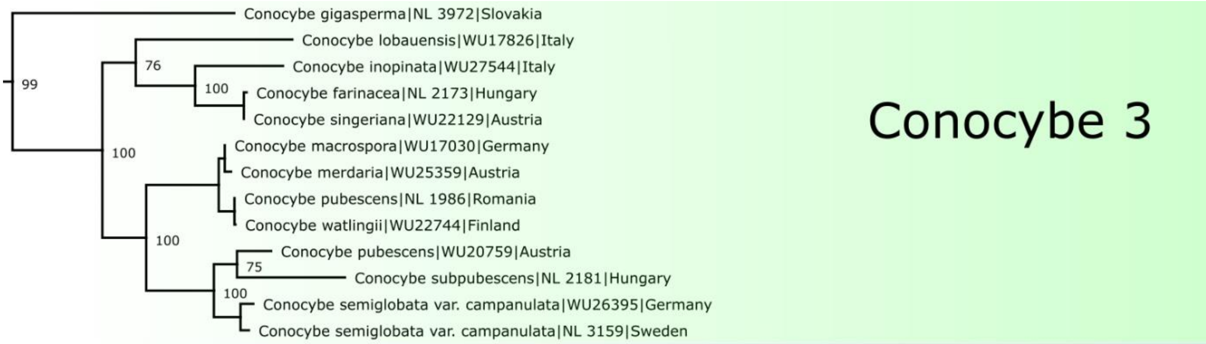
Conocybe JAC9736

Undescribed and known from a single collection.

JAC9736: with lageniform caulocystidia. 2-3-spored smooth, thick walled with germ pore 13 x 8um. Cheilocystidia lecythiform with head 4-4.5um.

JAC9736	JAC9736
	

Conocybe 3

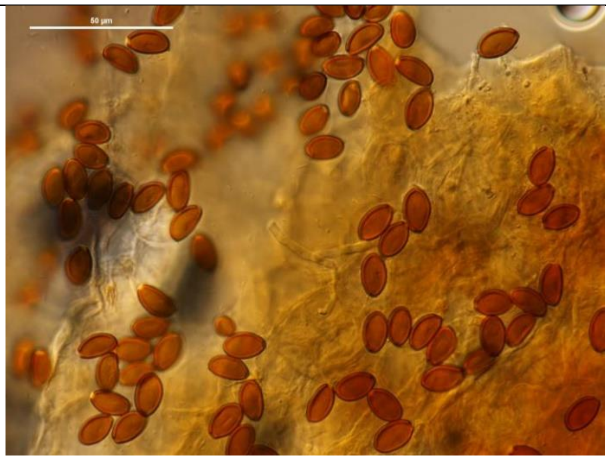


Conocybe pubescens

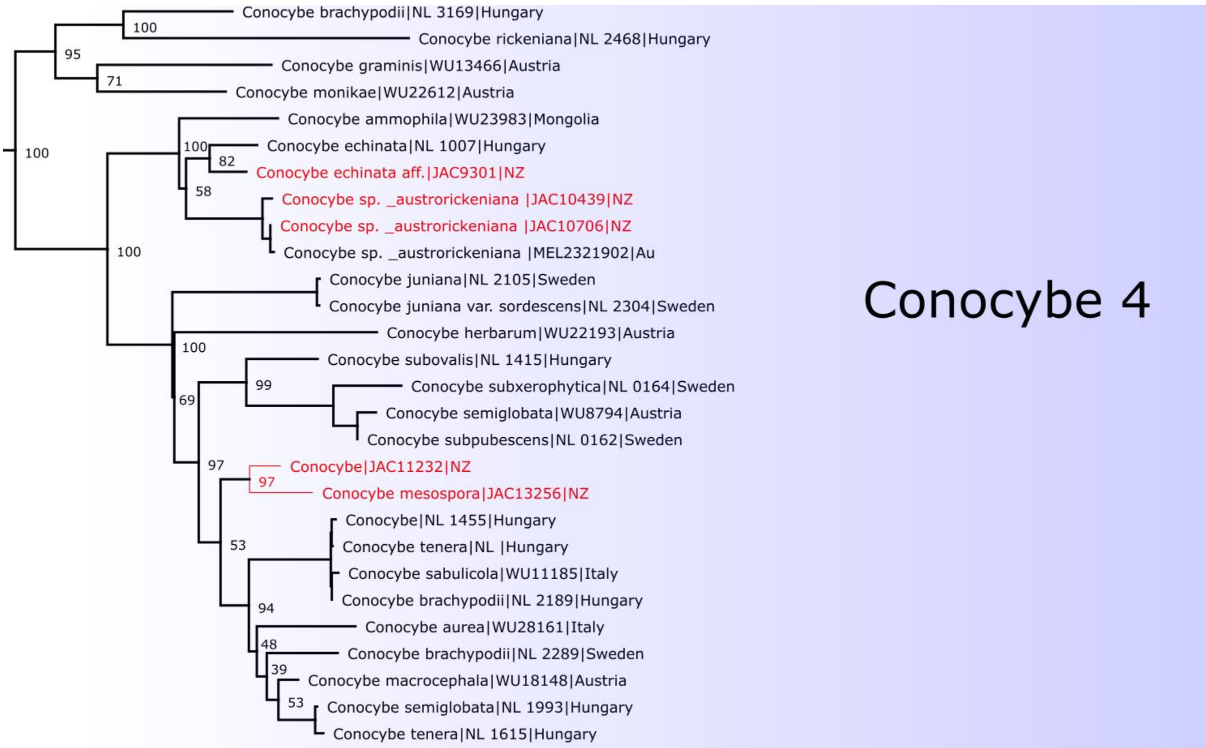
This species should appear in *Conocybe* 3 which to date has no New Zealand sequenced collections. This species occurs on dung.

PDD 85789: Caulocystidia of mostly irregular ellipsoid cells, no hairs observed, very few lecythiform elements. Surely section Pilosellae, not Mixtae? 4-spored. Stipe not radicant, but slightly enlarged at base. Cheilocystidia small, capitulum 3um. Spores with germ pore. A few short hair-like pilocystidia present. Spores 16 x 9um. Fits with C. pubescens apart from sparsity of lecythiform caulos.

PDD 73596: Pileus to 20mm. Stipe to 6cm. No ring or veil. Pileipellis hymeniform, with short lecythiform cystidia, 24 x 5um at apex, some encrusted. 4-spored, large germ pores, spores to 20 x 10um. Caulocystidia similar to PC, fascicles of lecythiform cystidia and short hairs. Cheilocystidia distinctly lecythiform, more so than PC. The material is consistent with the northern hemisphere C. pubescens, although the spores perhaps a little long. This species needs recollection and sequencing, especially to confirm the blueing of PP elements with alkali noted by Watling.

JAC85789 (Watercolour M. Taylor)	JAC85789
	

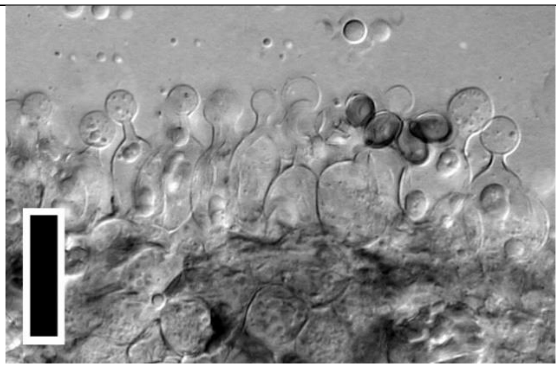
Conocybe 4



Conocybe echinata aff.

This species seems to be common in sheep paddocks, with a bulbous stem base and may be introduced.

JAC930: Spores thick-walled with germ pore 10 x 5.8um 4-spored

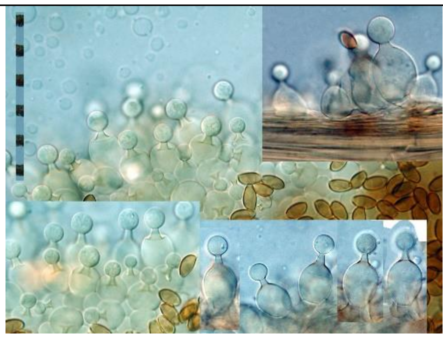
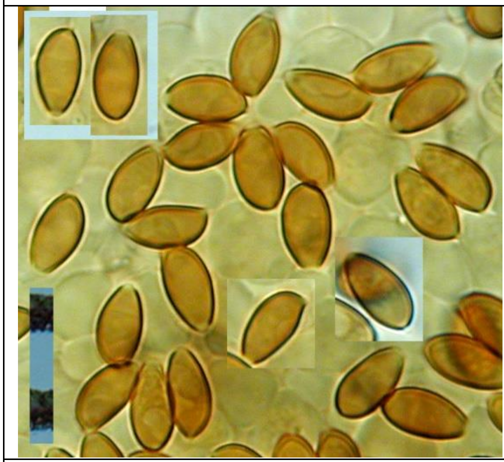
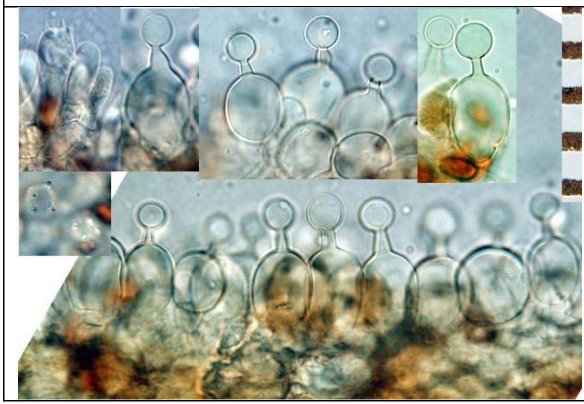
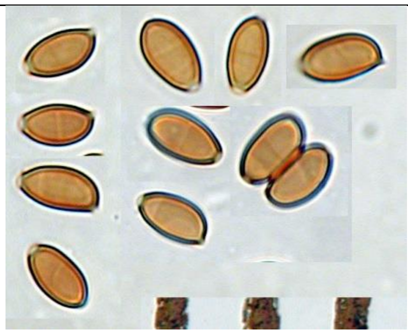
JAC 9301	JAC 9301
	

Conocybe sp. 'austrorickenianana'

This species common in lawns across New Zealand which keys to the northern hemisphere *C. rickenianana* but is not that species and is probably undescribed.

JAC10439: Spores 8.1-9.3(8.8) SD0.4 x 4.5-4.9(4.7) SD0.2

JAC 10706: Cheilo, pilo, & caulocystidia purely lecythiform. Spores smooth, with germ pore, 4-spored. Spores 8.4-9.6(8.8) SD0.4 n=11 x 4.6-5.2(4.8) SD0.2 n=10. Cystidial head 5.8-8.3(7.3) SD0.9 n=8

JAC10439	JAC10439
	
JAC10439	JAC 10706
	
JAC 10706	JAC 10706
	

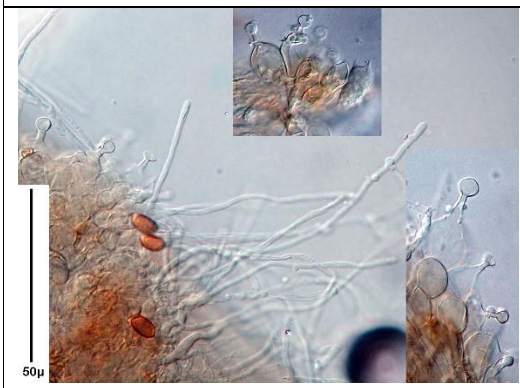
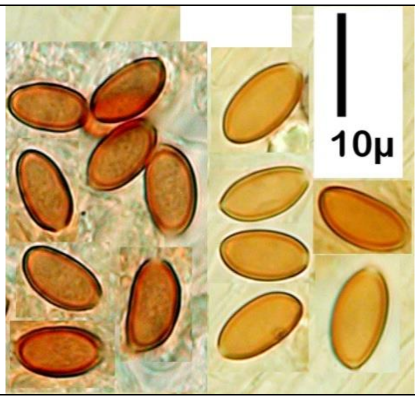
Conocybe mesospora cf.

A couple of sequenced collections are morphologically similar and perhaps equate to Watling & Taylor's *C. mesopora*. Our sequences are not the same as sequences from China as *C. mesospora*, but the species was originally described from France. It seems quite likely that our species, which is present in indigenous habitats, represent undescribed taxa.

JAC13256: stem with small bulb. Stem with sparse caulocystidia along entire length but prominent at apex and base. Stem with mainly lecythiform cystidia and some short and relatively broad cystidia (not hairs). Spores smooth with germ pore. 4-spored (perhaps some 2). Spores 10um.

JAC11232: stem strongly covered in cystidia along entire length. Without veilar remnants. Cheilocystidia lecythiform, spores smooth, with obvious germ pore, 4-spored, <10um. Caulocystidia a mixture of lecythiform and filiform cystidia. Spores length=7.8–9.8µm (µ=8.8, σ=0.5), width=4.3–

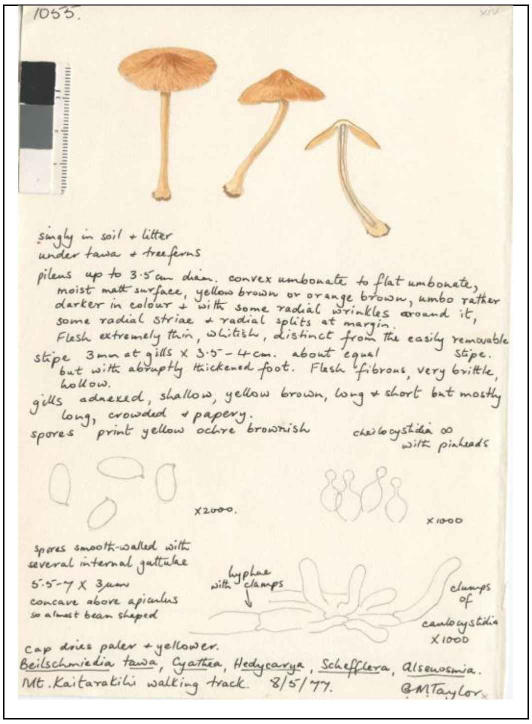
5.2µm (µ=4.8, σ=0.2), Q=1.7–1.9µm (µ=1.8, σ=0.1), n=15. Collections keying here but with slightly angled spores would conform to Watling & Taylor's C. sp. 3

JAC 13256	JAC11232
	
	

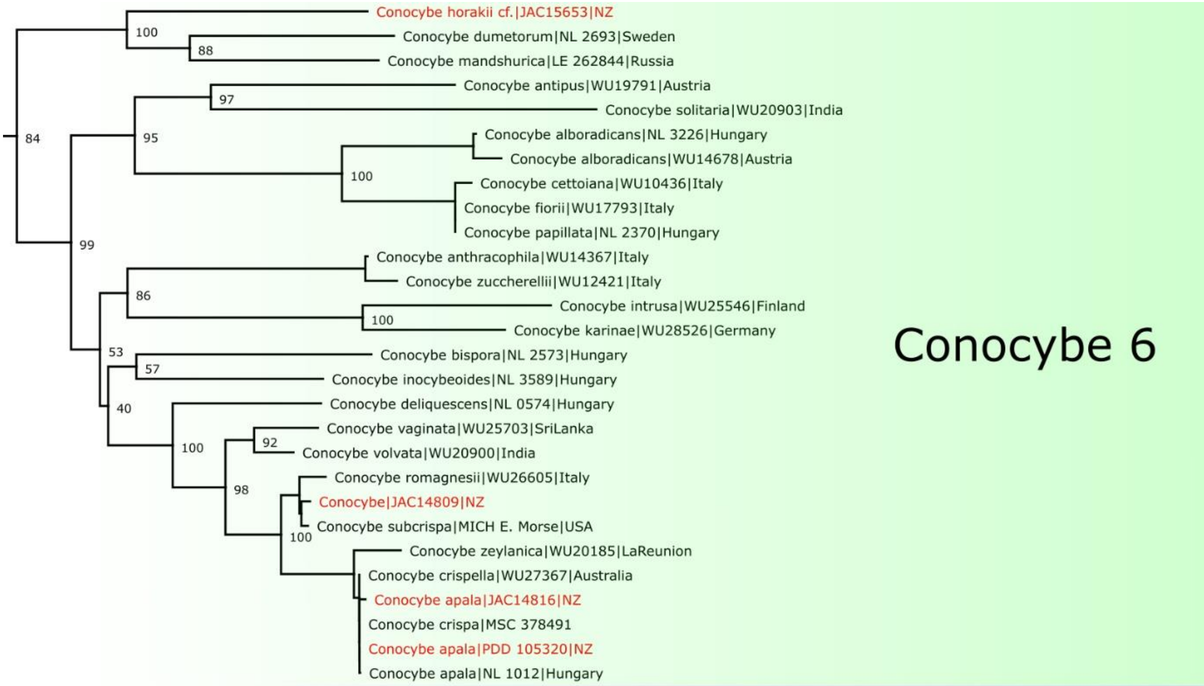
Conocybe pilosella

This species was included in Watling & Taylor as *C. piloselloides* and with spores lacking a germ pore or callus. The original species was described from Paris and later synonymised with *C. pilosella*. There are no recent collections.

PDD 110965	



Conocybe Clade 6 – section candidae p.p



Conocybe horakii

Easily distinguished because of the minutely ornamented spores.

JAC15635: [GS] Small mushrooms growing beneath the bark of a rotten pine log. Caps to 6 mm across. Stems and caps finely hairy. [JAC] minutely rough spores, lecythiform cystidia. The ornamented spores strongly suggest *C. horakii* except that described with stipe pubescent at the apex only. However that description is based on two collections and neither in PDD for examination.

JAC15635 (Photo G. Smith)	JAC15635 (Photo G. Smith)

Conocybe sp. JAC14809

The sequence of New Zealand material is almost identical to one from the USA labelled *C. subcrispa*. However, that species is described with much larger spores and quite different cystidia. *C. romagnesii*, also nearby in the phylogenetic tree, is described has having spores without a germ-pores, and this species does have them. Morphologically the species seems close to a pale version of *C. crispella*.

JAC14809: Caulocystidia fascicles of lageniform/ellipsoid cells, CC lecythiform, pilocystidia hair-like, spores length=10.3–12.1µm (µ=11.2, σ=0.58), width=7.4–8.8µm (µ=8.1, σ=0.47), Q=1.3–1.6µm (µ=1.39, σ=0.07), n=20

JAC14809 (Photo G. Smith)	JAC14809 (Photo G. Smith)
	

Conocybe apala

= *Conocybe huijsmanii*

This species seems to be common in lawns in the north of New Zealand and is introduced.

JAC14816: 4-spored. length=12.8–14.3µm (µ=13.3, σ=0.39), width=7.4–9.3µm (µ=8.4, σ=0.47), Q=1.4–1.8µm (µ=1.58, σ=0.11), n=20. Germ pore to 3um. Caulocystidia hairs and similar to pilocystidia.

JAC14816 (Photo P. de Lange)	JAC14816 (Photo P. de Lange)

	
PDD 105320 (Photo B. Weir)	PDD 105320 (Photo B. Weir)
	

Acknowledgements

This preliminary survey has relied heavily on collections, photographs provided by several people: Teresa Lebel (Adelaide Botanic Gardens), the late Ross Beever, Grey Smith (via iNaturalist), Peter de Lange (via iNaturalist), Christian Schwarz and Noah Siegel.

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