

## Mycological Notes 19: *Agrocybe parasitica* and related species.

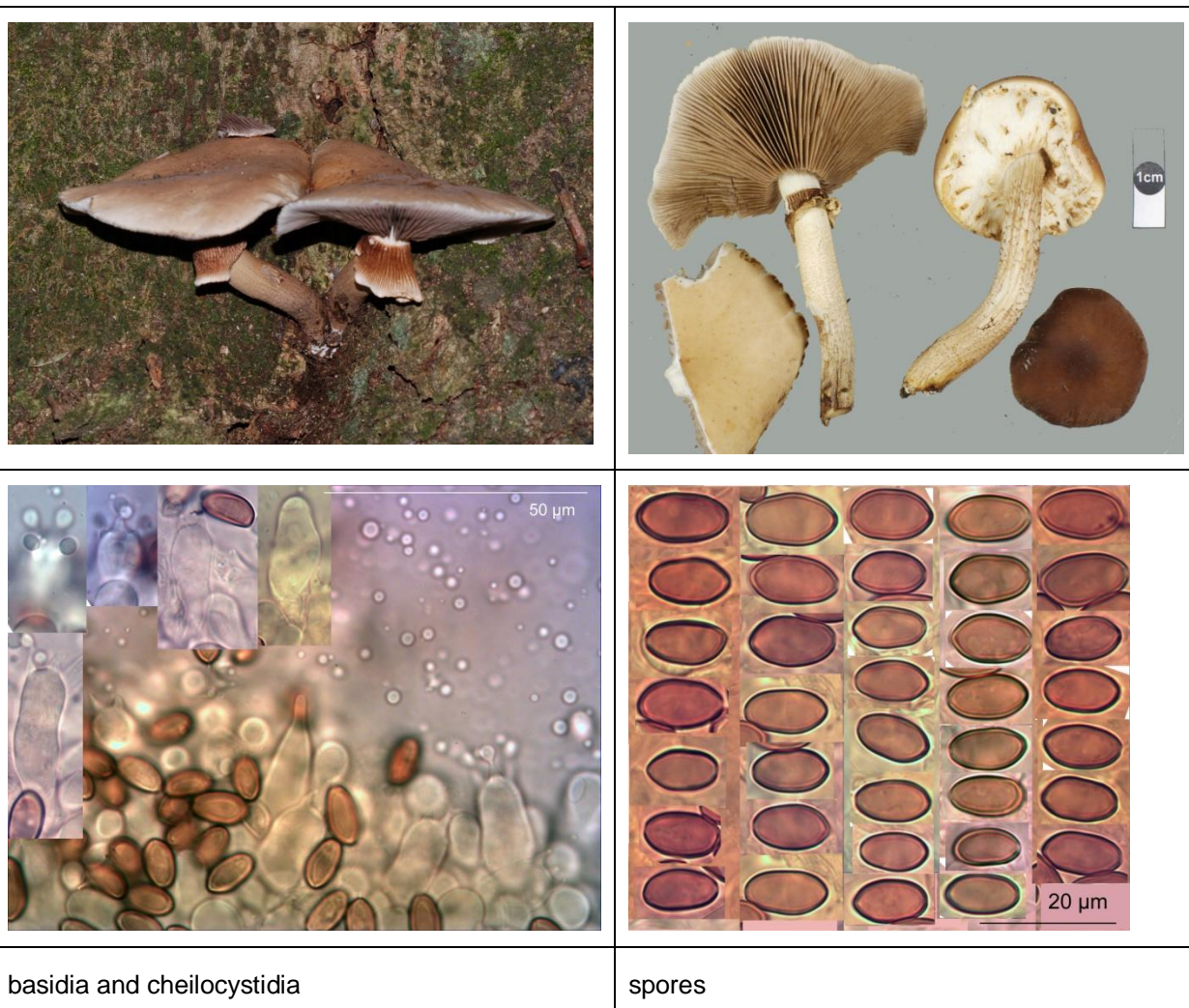
Jerry Cooper, December 17<sup>th</sup>, 2012

A collection of *Agrocybe parasitica* from the same locality and on the same host as the nomenclatural type was recently sequenced. Here I discuss the relationship between *A. parasitica*, *A. cylindrica* and related taxa around the world.

*Agrocybe parasitica* was described by Greta Stevenson in 1982 as a causal agent of heart rot of *Plagianthus* and *Hoheria*, and she noted its occurrence on a number of different introduced and indigenous trees, especially Tawa. The nomenclatural type was collected from Riccarton Bush, Christchurch on *Plagianthus regius*. Stevenson's description and drawings include 4-spored basidia, spores 9-12 x 6-7µm, with conspicuous germ-pore, ampulliform cheilo and pleurocystidia, and cystidioid cap elements. The same fungus has long been known in New Zealand, recorded as *A. cylindrica* by Taylor (1981), *Pholiota pudicus* (= *A. cylindrica*) by Masee (1898) and known as the edible Tawaka by Maori (Fuller et al, 2004). Watling & Taylor (1987) in their revision of New Zealand material state the fungus is almost certainly indigenous, and they note 2 & 4-spored basidia. *A. parasitica* is also recorded from Australia (Fuhrer, 2005; Hood, 2002) and Hawaii (Hemmes & Desjardin, 2002). None of these authors explicitly state the characters by which to differentiate *A. parasitica* from *A. cylindrica*, which is also known as a weak parasite often emerging from wounds high on living trees.

Singer (1950) considered *A. cylindrica* (1815) to be a nomen. confusum and thus used the later name, *A. aegerita* (1824). Watling & Gregory (1981) disagree. Here we follow Watling in using the earlier name *A. cylindrica* but both names are in current use.

***Agrocybe parasitica***, ex-Type locality, JAC 11711 (PDD 95998), on living tree of *Plagianthus regius*, 13<sup>th</sup> Feb., 2011, Riccarton Bush, Christchurch. ITS Genbank JQ694119.

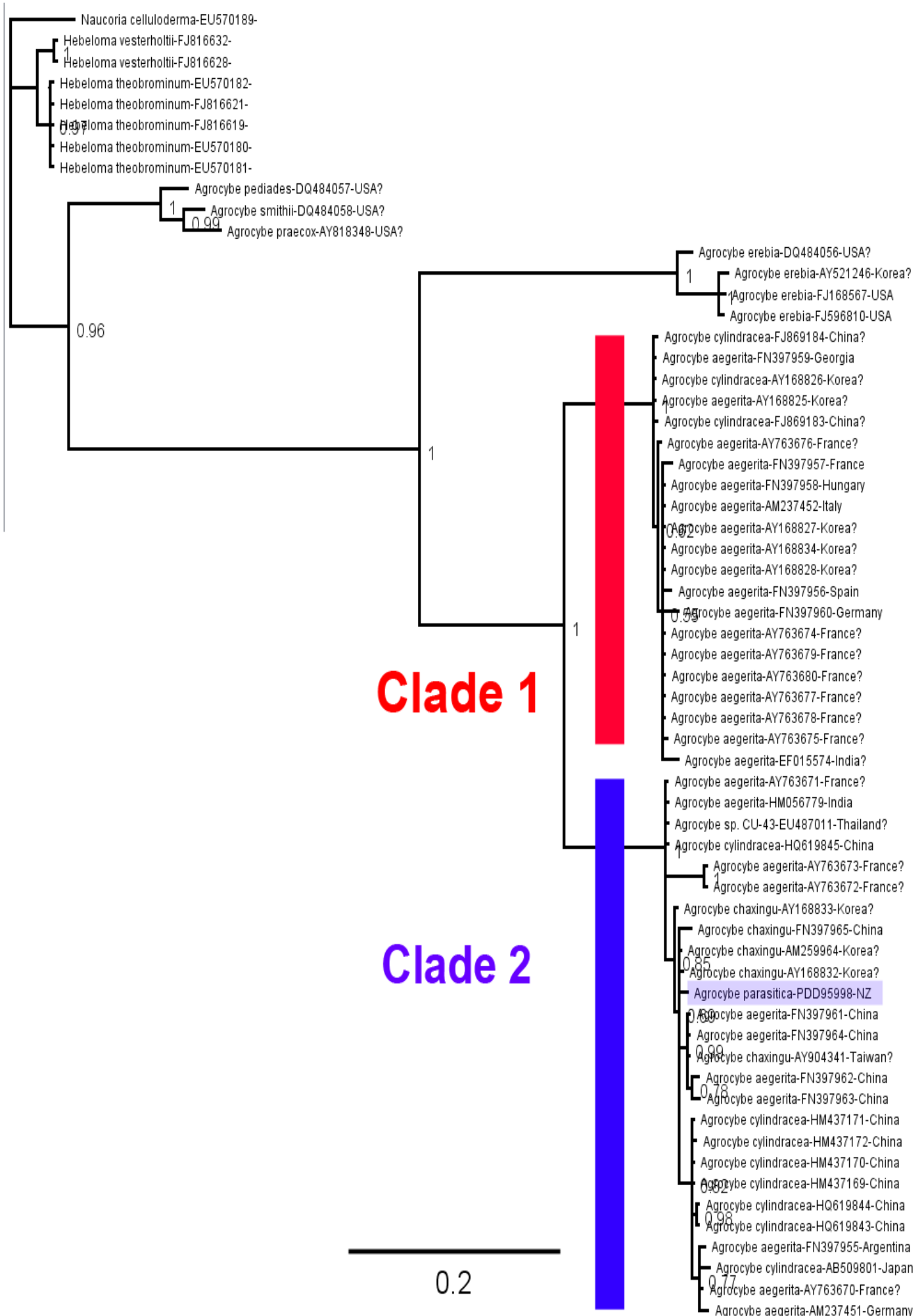


## Previous molecular studies

Sirand-Pugnet & Labarere (2002) sequenced the PRI3 gene of material named *A. cylindrica* from France, Czechoslovakia, Italy, Argentina, Guatemala, China and Thailand. They found a divergence between European and Asian/Latin American material. Uhart and Alberto (2007) studied a number of collections from Argentina, Guatemala, China, Japan, France, UK. They distinguished two morphotypes: one with 1-4-spored basidia and spores 9-11 x 5-6µm recorded from Central and South America, Europe and Asia, and material with just 2-spored basidia and spores 10-16 x 5-9µm recorded only from South America. An obvious question therefore whether these two morphotypes relate to the Sirand-Pugnet & Labarere's two divisions. Uhart & Alberto also observed that *A. chaxingu*, a species described from China, conformed to the 1 to 4 spored morphotype. Uhart and Alberto (2009) after further fertility experiments described a new species *A. wrightii* for a South American taxon also conforming to the 1 to 4 spored morphotype. They concluded that other S. American taxa of the 1-4-spored type were not *A. wrightii*, and other 2-spored morphotypes could not be called *A. cylindrica*, because of the broad and imprecise application of that name to both 1-4 and 2-spored morphotypes. Colac et al (2011) provided a morphological distinction between European and Asian strains of *A. cylindrica*. They recognised an Asian strain with a veil that separates later, is larger and covered with spores, but noted that Asian and European strains are interfertile despite large differences in the studied cob gene. *A. parasitica* conforms to the Asian morphology.

## This study

ITS sequences in Genbank for *Agrocybe* form a monophyletic group within which there are two distinct clades associated with a number of collections labelled *Agrocybe cylindrica/aegerita*.



Clade 1 contains just collections *A. cylindrica/aegerita*. Clade 2 contains, in addition to collections also labelled *Agrocybe cylindrica/aegerita*, other collections labelled *A. chaxingu* and our *A. parasitica*. Clade 2 shows slightly more internal structure than Clade 1. The differences within both clades are small (13bp in Clade 1 and 20 bp in Clade 2) and it is debateable, on the basis of ITS at least, whether any groups within the clades are worthy of separation at species level, or simply divergant populations of the same taxon. The differences between Clade 1 & Clade 2 certainly represent a species-level split. Clade 1 contains collections from France, Italy, Spain, Germany Hungary, Georgia, India, Korea and China. Clade 2 contains collections from France, Germany, India, Thailand, China, Taiwan, New Zealand and Argentina. We can conclude that at least two distinct species are hiding under the name *A. cylindrica* in Europe and both taxa are globally distributed in the northern hemisphere, and with a potentially restricted distribution in the southern hemisphere. But what names to apply to these clades? How do they relate to the 1 to 4 spored and 2-spored morphotypes previously found? Variability in this globally distributed species complex has long been recognised, and the most inclusive synonymy (including both clades) would include at least the following names:

### **Nomenclator for names relating to the *Agrocybe cylindrica* complex**

**Agrocybe aegerita** (V. Brig.) Singer, Lilloa 22: 493 (1951) [1949]

=**Agaricus aegerita** V. Brig., Rev. Bot. Courrensan 1: tab. 1 (1824) [Type from Europe]

**Agrocybe aegerita var. rugosovenata** Singer, Revue Mycol., Paris 18(1): 19 (1953), according to Watling. [Type Argentina on Allophyllous]

**Agaricus attenuatus** DC 1815 [according to Flora Agaricina Neerlandica 2005; Type from France]

**Agaricus capistratus** Cooke, J. Bot., Lond. 1: 65 (1863) [Type from UK]

**Agrocybe chaxingu**

**Agaricus crassivelus** Speg. 1887 [according to Singer 1951; Type from South America]

**Agrocybe cylindrica** (DC.) Maire, Mém. Soc. Sci. Nat. Maroc. 45: 106 (1938) [name & spelling sanctioned by Fries, Epicrissis 1838, p164]

=**Agaricus cylindricus** DC., in Lamarck & de Candolle (1815) [Type from Europe]

**Pholiota formosa** Speg 1926 [according to Singer 1951; Type from South America]

**Pholiota impudica** Speg 1889 [according to Singer 1951; Type from South America]

**Agaricus leochromus** Cooke, Illustrations of British Fungi (Hymenomycetes) 3: pl. 384 (1863) [Type from UK]

**Agaricus luxurians** 1838 [Type from Europe]

**Agaricus mollisporium** 1891 [according to Watling 1992; Type from UK]

**Agrocybe parasitica** 1982 [Type from New Zealand]

**Agaricus phyllicigenus** 1877 [according to Singer 1986; Type from Tristan da Cunha; spores variable in size]

**Agaricus pudicus** 1793 [according to Watling 1977, Watling BFF1982, but for Singer 1986 = *Leucoagaricus*]

**Agaricus strobiliformis** [according to Watling 1992]

**Agaricus strobiloides** 1837 [Type from Italy]

**Agaricus viviani** 1874 [Type from Europe]

### **Representative Taxon Concepts**

Overholts1925, *Agrocybe aegerita*. on deciduous trees, spores 10 x 5

Massee 1892, *Agrocybe aegerita*. on Poplar, spores 10 x 5.

Watling 1982 *Agrocybe cylindrica* on Poplar etc, spores 9.5 x 6

Watling 1986, *Agrocybe cylindrica*. on Poplar, 4-spored.

B&B 1995 *Agrocybe cylindrica*, on Poplar 4-spored 10x5

FAN *Agrocybe cylindrica*, usually 4, sometimes 2 spored, spores 10 x 5.5

Singer 1951. *Agrocybe aegerita* includes *Agrocybe impudica*, *A. formosa*, and *A. crassivela*, all from South America, and have some 2-spored basidia and spores to 14-15.5µm.

Speg. *Agrocybe crassivela*, spores 10-11 x 6-7, on Poplar

### What names to apply to Clades 1 & 2?

In general the current sampling and available information on types does not allow us to say for certain which names apply to which clades, or even decide if *Agrocybe parasitica* is the correct name for the New Zealand fungus. However, the work of Uhart and Alberto suggest there are perhaps some relevant stable micro characters. As far as I can tell from the literature available to me, northern hemisphere descriptions consistently include a 4-spored taxon with spores around 10 x 5µm, without a germ pore and commonly associated with Poplar or Willow. Singer, in discussing South American collections on various hosts included in synonymy a number of species with 2 or 4-spores, larger spore size, and with a germ pore. He also noted differences in collections from around the world with respect to abundance and shape of pleuro and cheilocystidia, but the publications and observations on New Zealand material suggest intergradation of cystidial characters and so in my opinion less weight should be placed on cystidial morphology. Watling (1992) in a relevant discussion of *A. cylindrica* in Brazil specifically notes one of these species, *A. crassivela* from Argentina, as a robust strongly veiled species, 2-spored (11-13 x 6-7µm) with both lanecolate and vesiculose cheilo and pleurocystidia, and notes a 'disturbing range of morphological variation'. *A. crassivela* is an early name for South American material and may have nomenclatural importance. However it was described from Poplar and may represent a northern hemisphere introduction. Watling recognised that European material on hosts other than Poplar has abundant pleurocystidia, narrower spores (4-6µm), and cystidioid cells in the pileipellis (like *A. parasitica*). In discussing *A. parasitica* he notes the conspicuous germ-pore, and characteristic ampulliform cheilo and pleurocystidia, shared with some other southern hemisphere species. He also notes this form, and possibly another species occur in Australia.

More recent descriptions of *Agrocybe cylindrica* from Europe include references to 2-spored basidia (and spores with or without germ pores), but it is unclear if this relates specifically to examined European material, or a subsequent consequence of incorporating Singer's inclusive global synonymy which includes his 2 & 4 spored South American taxa. The evidence I can find suggests that in Europe at least there is a strictly 4-spored taxon without a germ pore, but there also exists strictly 2-spored and 1 to 4 spored taxa, with pored spores. The morphological data for *Agrocybe parasitica* creates further diversity because it conforms to Uhart and Alberto's 1 to 4 spored morphotype, but has spore size conforming to their 2-spored morphotype.

So, is it possible to deduce anything from this abundance of names and variability in descriptions? It seems reasonable that *Agrocybe aegerita* is the name best applied to the taxon common on Poplar and Willow in Europe, which is perhaps consistently 4-spored, 10 x 5µm and without a germ pore. This is most likely represented by Clade 1. Clade 2 includes *Agrocybe parasitica* which has larger, more variable spores (9-12 x 6-7µm), perhaps associated with occasional 2-spored basidia, and spores with an obvious germ pore. I can find no detailed description of *Agrocybe chaxingu*, an Asian cultivated species also in Clade 2, but Uhart and Alberto indicate it belongs to the 1 to 4 spored group and according to Collac (2011) it is morphologically similar to *A. parasitica* and is very probably a synonym. This clade also contains material from Argentina. We know that *A. crassivela* from Argentina is described as strictly 2-spored (Watling 1992), and *A. wrightii* with 1 to 4-spored basidia and smaller pored spores. Fertility experiments suggest *A. wrightii* is not *Agrocybe cylindrica* sensu Clade 1 and may represent a separate taxon, perhaps belonging to Clade 2. A strictly 2-spored taxon from the South could be recognised as *Agrocybe crassivela*. *Agrocybe parasitica* is a 1 to 4 large spored/pored taxon, but may compete with *Agaricus phlycigenus* from Tristan da Cunha which is described with spores of variable size. However, we know from looking at Clade 2 that representatives are also present in Europe (perhaps Watling's broader spored taxon on non-*Populus*/*Salix* hosts?), and so there remain quite a number of earlier European names which cannot be excluded without examination of types. Many of these older names may not be represented by physical types, which complicates the issue. More representative sequenced material from around the world, especially South America and Europe, need more detailed morphological descriptions to correlate phylogeny with morphology with available names. I think it possible that both *Agrocybe parasitica* (Clade 2) and *Agrocybe cylindrica* (sensu Clade 1) are both present in Australia and New Zealand (as indeed they are in Asia

and Europe). New Zealand collections of *Agrocybe parasitica* on hosts other than *Plagianthus* and *Hoheria* should be examined in detail.

## Conclusions

So we can conclude that the northern hemisphere has at least two distinct taxa hiding under the name *Agrocybe cylindrica*. *Agrocybe parasitica* (Clade 2) is almost certainly not the same as *Agrocybe cylindrica* (sensu Clade 1). It is differentiated most definitively by the presence of a germ pore, and perhaps less definitively by possessing some 2-spored and therefore larger spores, and macroscopically by having a larger and stronger veil which separates later. Like *A. cylindrica* the evidence suggest it is also a globally distributed taxon (accepting some minor ITS variation) and will therefore almost certainly have an earlier name. Certainly *Agrocybe parasitica* is proven to be equivalent to *A. chaxingu* and provides an earlier name for that. *Agrocybe cylindrica* sensu Clade 1 should also be sought in New Zealand.

4-spored only, spores 10 x 5, no pore, Europe, Asia, Clade 1?	<i>Agrocybe aegerita</i>
1 to 4 spored, spores 9-12 x 6-7, large pore, New Zealand, Australia, Hawaii, Clade 2	<i>Agrocybe parasitica</i> (plus potentially available European, South America and Tristan da Cunha names)
1 to 4 spored, spores 9-10 x 5-6, small pore, South America, Clade 2?	<i>Agrocybe wrightii</i> (plus potentially available European names)
2 spored only, spores 11-13 x 6-7, pore xxx, South America, Clade 2?	<i>Agaricus crassivelus</i>

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