Caloboletus kluzakii newly recorded from Britain (or will the real *C. radicans* please step forward)

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The well known bolete *Boletus radicans* was described by Persoon in 1801. The often used but later name *B. albidus* Roques published in 1841 is considered illegitimate as the even earlier *B. albidus* Schaeff. 1774 takes precedence, however that name is considered to represent the polypore *Amaropostia stiptica*.

Often of imposing size with a white to greyish buff cap, yellow pores that bruise blue and a fat yellow stem covered in a very fine, concolorous reticulum, *B. radicans* has for many years been one of the easier to identify species.

It remained in the genus *Boletus* until it was transferred by Vizzini (2014) to his newly erected genus *Caloboletus*, along with another familiar species *B. calopus*, which was selected to be the generic type. A number of other closely related species are found in North America and likewise transferred to *Caloboletus*. The species in *Caloboletus* are characterised morphologically by their yellow pores (never red) which bruise blue, often but not always with a reticulum on the stem, yellowish flesh bruising blue in some part and a very bitter taste to their flesh. Many species, but again not all, are bright red over some portion of their stem. A photograph of what is usually considered to be a typical *C. radicans* is shown in Fig. 1.

In 2006 a new species, *Boletus kluzakii* was described from the Czech Republic (Šutara & Špinar, 2006), to replace the earlier (1988) but illegitimate name *B. fallax* Kluzák. It was described as closely related to *B. radicans* but



Fig. 1. A collection agreeing with the typical description of *Caloboletus radicans*. Richmond Park, Sept. 17, 2020. Photograph © Geoffrey Kibby.

differing in developing a pink-flushed cap due to the presence of a reddish subcuticular layer which becomes progressively exposed as the pallid cuticle collapses and/or is worn away. The reddish cap colour immediately intensifies when scratched or bruised. Its yellow, reticulate stem is often flushed reddish brown at the base. *B. kluzakii* was transferred by Vizzini (2014) to the genus *Caloboletus* at the same time as *B. radicans*.

So in the years following its publication GK had been on the lookout for this pink-flushed species in Britain but without success. Recently however a number of reports have been surfacing on social media platforms across Europe of collections verified as *C. kluzakii* by molecular sequencing but without showing any of the characteristic pink tones in the cap. This meant that there were collections that by morphology alone were very difficult to separate from *C. radicans*.

It was not a surprise therefore when news arrived that two sequenced collections in the Kew Fungarium, identified by GK as *C. radicans* had yielded DNA barcodes that closely matched the sequence from the holotype of *C. kluzakii*. Two other Fungarium collections sequenced by David Parfitt (Cardiff) in preparation for the official Red List of British boletes (Ainsworth *et al.*, 2013) and originally determined as *Boletus* (now *Butyriboletus*) *fechtneri*, had also yielded similar sequences. At the time these barcodes had been interpreted by AMA as representing *C. radicans*. Further sequencing work carried out at Kew in 2013 and 2014 by Bryn Dentinger, Kevin King and Laura Suz revealed that there were two closely related species present in Britain, but was either the true *C. radicans*? Until a sequence derived from a type or epitype of *C. radicans* becomes available for comparison, this remains a tricky question to answer.

At the time of writing, six British collections of *C. kluzakii* have been identified in the Kew Fungarium:

• K(M) 53938 coll. G.C. Dickson 15 Sept. 1991, South Hampshire VC11, New Forest, East End Pond, SZ3697, near *Quercus* sp. Received as *B. albidus*.

• K(M) 163906 coll. E.W. Brown 28 July 2009, Surrey VC17, Richmond Cemetery, near *Fagus sylvatica*. Identified by E.W.B. & A. Henrici as *B. fechtneri*.

• K(M) 163909 coll. E.W. Brown 31 July 2009, Surrey VC17, from the roadside outside Brookwood Cemetery, near to *Quercus ilex*. Identified by E.W.B. & A. Henrici as *B. fechtneri* suggesting that there must have been some



Fig. 2. *Caloboletus kluzakii*. This is the collection by Ted Brown cited above K(M) 164043 from Richmond Cemetery. Note the very slight red flush on the stem of the left-hand specimen. Photo © Geoffrey Kibby.



Fig. 3. *Caloboletus kluzakii* collected by K. Davies from the Forest of Dean, K(M) 194203. There is a narrow band of reddish pigment visible on the stem but the cap shows little evidence of any pink tones. Photo © K. Davies.

obvious red banding on the stem of this and the previous Surrey collection (see above) to give that impression.

• K(M) 164043 coll. E.W. Brown 09 Aug. 2009, Surrey VC17, Richmond Cemetery, TQ1974, under *Quercus* (Fig. 2). Its stem was perhaps a little more slender than usual for *C. radicans* and had some hints of red in some parts but was identified by GK as *B. radicans*.

• K(M) 194203 coll. K. Davies 19 Aug. 2014, West Gloucestershire VC34, Forest of Dean, Berry Hill, SO575129, near *Fagus* and *Castanea* (Fig. 3). Sent to GK as a possible *Imperator torosus* but differed from that species in a number of respects and was subsequently identified by GK as *B. radicans* and looking strikingly like 'normal' *C. radicans*.

• K(M) 194202 coll R.A. Fortey 08 Sept. 2014, Oxfordshire VC23, Henley-on-Thames, Badgemore Golf Course footpath, SU745834, in short grass near to grove of trees and near *Fagus sylvatica* & *Castanea sativa*. R.A.F. thought this was an unusual collection and noted "Taste mild and cut flesh strongly carmine in stipe base".

The collection by K. Davies was tested with Melzer's iodine solution at GK's request and found to produce a strong blue-black reaction on the stem flesh; this contradicts the usual negative reactions quoted for *C. radicans* and in the original description of *C. kluzakii* (Šutara & Špinar, 2006). The collection by R.A. Fortey was mild to taste, again in contradiction to the bitter taste usually recorded for *C. radicans* and to Šutara & Špinar's (2006) protologue for *C. kluza-kii*.

Although these two collections seem to have characters which are difficult to reconcile with the descriptions of either *C. kluzakii* or *C. radicans*, the others tend to support the opinion of many boletologists expressed during online discussions that it may not be possible to definitively separate *C. kluzakii* from *C. radicans* based purely on morphological characters as many of these appear to overlap. The strong reaction of the K. Davies collection to Melzer's iodine solution when fresh (no reaction observed by AMA when the preserved material was retested in 2022) is interesting however and it would be very useful to record the reaction in as many collections of *C. radicans/C. kluzakii* as possible, preferably followed by sequencing to confirm which species is involved.

Those DNA-enabled mycologists who might wish to compare their own library of bolete sequences with those deposited in GenBank to try to detect further examples of C. kluzakii should be aware of an important and potentially confounding factor. At the time of writing, the ITS2 region of the deposited sequence derived from the holotype of this species (KU317750) is not of optimal quality. Indeed it was not retrieved as a close match during GenBank searches involving any of our sequences, a situation which others have also warned about online. In particular, Bálint Dima has suggested that anyone who has a sequence closely matching EU417872, labelled in GenBank as "Boletus fechtneri voucher Noordeloos MEN 9336", will have found C. kluzakii.

Another Caloboletus conundrum

Boletus calopus is another very familiar and supposedly well known species and, as already mentioned, it was made the generic type of *Caloboletus*. But it has become apparent across Europe when boletologists have produced phylogenetic trees that 'calopus' collections fall into several discrete terminal clusters. In discussions with other mycologists online it has been suggested that there may be as many as three to five species involved across Europe.

Boletus pachypus is a name included in many early books as a separate species from *B. calopus*, differing mainly in the colours of the stem and cap. In recent works it has usually been regarded as a synonym of B. calopus (although Species Fungorum regards *B. pachypus* as a synonym of C. radicans). It seems likely however that B. pachypus at least may be resurrected at some point, typified with a modern collection and recombined in Caloboletus. During studies by AMA of putative Butyriboletus fechtneri specimens, one collection, K(M) 169403 made by Alan Hills on 29 July 2004 from South Hampshire VC11, New Forest, Gritnam Wood, SU280060, with Quercus and Fagus, proved to be a very good match (99.7%)with GenBank sequence KU317751 labelled B. pachypus. This is B. pachy*pus* sensu Zhao, Wu & Yang as represented by the German voucher collection MB000275. So it seems certain that we have two taxa at least in Britain, one being presumably the true *Caloboletus calopus* and the other *B. pachypus*, should that become the accepted name.

So once again carefully dried collections morphologically close to *C. calopus* are required for sequencing, particularly with a range of different trees and with accompanying detailed notes and photographs of their morphological characters. Hopefully some consistent morphological characters may be found to allow separation of the species without necessarily having to obtain sequences for every collection in future.

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