

Heimioporus (Boletineae) in Australia

Roy E. Halling^{1,3} and Nigel A. Fechner²

¹Institute of Systematic Botany, The New York Botanical Garden, Bronx, New York 10458, United States of America. ²Queensland Herbarium, Brisbane Botanic Garden, Mt Coot-tha Road, Toowong, Brisbane, Queensland 4066, Australia.

³Author for correspondence. Email: rhalling@nybg.org.

Abstract

Two species of *Heimioporus* are fully documented, described and illustrated from recent collections gathered in Queensland. While *H. fruticicola* is known only from Australia so far, the specimens of *H. japonicus* from Fraser Island and Cooloola represent a new report and significant range extension for this bolete.

Key words: Boletes, mycorrhizae, Australia, biogeography.

Introduction

Heimioporus was proposed by Horak (2004) as a new name to replace the bolete genus *Heimiella* Boedijn non Lohmann (1913). As many as 14 species were included by Horak (2004), but as envisaged here, the genus circumscribes 10 species. These have olive-brown spores which are alveolate-reticulate to reticulate or with pit-like perforations, extremely rarely rugulose and then with crater-like pits; they are elongate-ellipsoid to short ellipsoid, and lack a suprahilar plage. Boedijn (1951) included only the type species of his genus (*Boletus retisporus* Pat. & C.F. Baker) in the circumscription. The main feature emphasised by Boedijn was the subvoid, reticulated spores. Later, Heim (1963), Hongo (1969, 1973), Corner (1972, 1974), and Zang (1985) described some new species. Singer *et al.* (1983) described *H. ivoryi* from Belize (as a *Boletellus*), while Watling (2000) and Watling & Hollands (1990) described additional taxa and provided some re-alignment to the genus with known species (e.g., *H. betula*, *H. fruticicola*). During this time, *Heimioporus* was accepted reluctantly by Corner (1972; as *Heimiella*, for the six species known to him) who noted no clearly demarcated adaxial patch (plage) compared with *Strobilomyces*. While that comparison seems an odd one, given that the spores share only a reticulate ornamentation, other Boletineae do show an adaxial plage area. In contrast, Singer (1986, and earlier editions) did not accept segregation from *Boletellus* and placed all of those reticulate spored taxa into *Boletellus* along with others that have smooth and/or ribbed spores. Recently, strict consensus phylogenetic analyses obtained by Osmundson (2009) using three gene loci (nuLSU, *atp6*, *tef1*) clearly infer *Boletellus* and *Heimioporus* as separate genera. *Heimioporus fruticicola* is the only species of the genus known from Australia so far. On the basis of recent collections, we can now provide a more detailed description of *H. fruticicola*, and a new record of *H. japonicus* as occurring in Australia.

Materials and Methods

General colour terms are approximations, and the colour codes (e.g., 7D8) are page, column, and row designations from Kornerup & Wanscher (1983). All microscopic observations were made with an Olympus BHS compound microscope equipped with Nomarski differential interference contrast (DIC) optics, and measurements were from dried material revived in 3% KOH. The abbreviation Q refers to the mean length/width ratio measured from *n* basidiospores, and *x* refers to the mean length × mean width. Scanning electron micrographs of the spores were captured digitally from a Hitachi S-2700 scanning electron microscope operating at 20 kV. Hymenophoral fragments were removed from dried basidiomata, mounted directly on aluminum stubs using carbon adhesive tabs, and coated with 10 nm of gold using a Hummer II sputter coater. Herbarium acronyms are those designated in the online version of Index Herbariorum (Thiers, continuously updated).

Taxonomy

Key Macroscopic Features

- 1a. Pileus matted subtomentose; stipe pseudo-reticulate to subpruinose-ridged to subscabrous..... *H. fruticicola*
- 1b. Pileus subvelutinous; stipe coarsely but shallowly lacerate-ridged with a dense red pruina overlaying the ridges..... *H. japonicus*

Heimioporus fruticicola (Berk.) E. Horak, *Sydowia* 56: 240. 2004.

Figs 1A, 2C–D, 3C–D, 4

Boletus fruticicola Berk., *London J. Bot.* 7: 574. 1848.

Suillus fruticicola (Berk.) Kuntze, *Rev. Gen. Pl.* 3(2): 535. 1898.

Austroboletus fruticicola (Berk.) E. Horak, *Sydowia* 33: 76. 1980.

Heimiella fruticicola (Berk.) Watling & Hollands, *Notes Roy. Bot. Gard. Edinburgh* 46: 420. 1990.

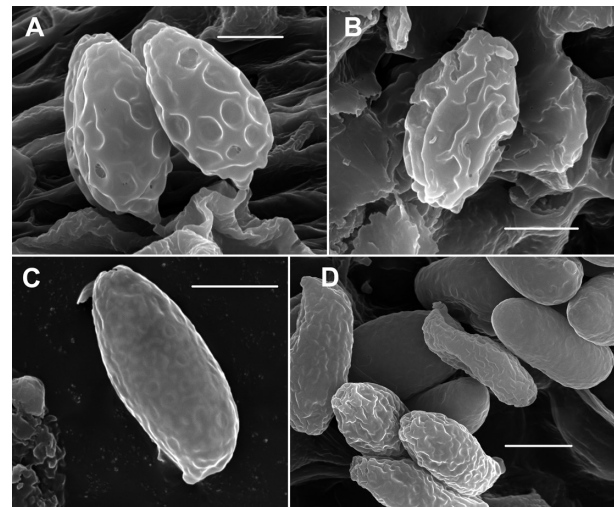
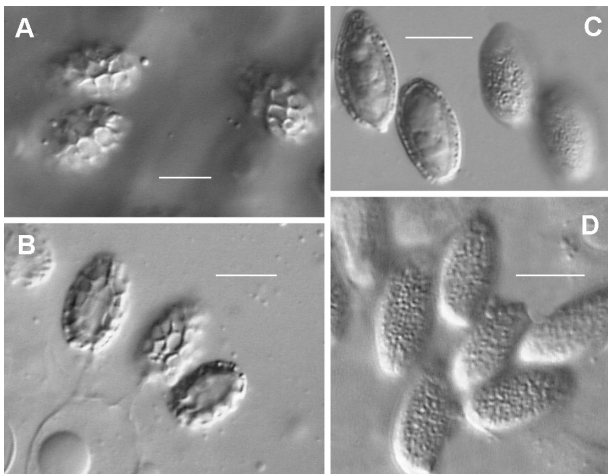
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Fig. 1. Habits of *Heimioporus*. **A** *Heimioporus fruticicola* (Halling 8970) $\times 1$. **B** *Heimioporus japonicus* (Halling 9288) $\times 1$. **C** Stipe surface detail of *H. japonicus* (Halling 9288) $\times 2.5$.

Fig. 2. (next page left) Light micrographs with Nomarski DIC of spores of *Heimioporus*. **A** *H. japonicus* (holotype). **B** *H. japonicus* (Halling 9288). **C** *H. fruticicola* (holotype). **D** *H. fruticicola* (Halling 8970). Scale bars = 10 μm .

Fig. 3. (next page right) Scanning electron micrographs of spores of *Heimioporus*. **A–B** *H. japonicus* (Halling 9288). **C–D** *H. fruticicola* (Halling 8970). Scale bars = 5 μm .



Pileus (2.5–) 4.5–8 (–9.5) cm broad, convex to plano-convex to plane, viscid when wet, soon dry, matted subtomentose, red to lake red (10C8, 9C–D8,7), fading to near greyish red (7B4), somewhat blotchy with age; *flesh* pale yellow when young, white with age, not blueing, or very rarely with a hint of pale blue, with mild odour and taste. *Tubes* 10–13 mm deep, adnexed to depressed around the stipe, pale yellow to yellow becoming greenish yellow, (3A6 to 3E6) or dull yellowish green to olive, not blueing, or only slightly with injury; *pores* concolorous, 1–2 per mm, rarely blueing, and eventually staining pale brown. *Stipe* (3–) 5.5–8 cm long, 1–1.5 (–2) cm broad, dry, straight or curved, terete or flattened, \pm equal to broadly subclavate, or tapering downward, usually pinched at the base, white to pale yellow to pale greenish yellow at apex, yellow at base, pseudo-reticulate to subpruinose-ridged to subscabrous with scabrosity confined to the ridges; these red or pink on pale yellow to yellow ground colour; *interior* solid, pale yellow to yellowish white, unchanging; basal mycelium white.

Basidiospores 11.2–16.1 \times 5.6–7.7 μm , ($n = 16$; $x = 13.87 \times 7.08 \mu\text{m}$; $Q = 1.96$), subfusoid to ellipsoid, rugulose with crater-like pits, inamyloid (rarely lightly dextrinoid), honey brown in KOH. *Basidia* 25–35 \times 12–15 μm , clavate, 4-sterigmate, hyaline. *Hymenophoral trama* bilateral, of the *Boletus*-subtype, with cells 4.2–8.4 μm broad, hyaline, fleetingly amyloid in Melzer's. *Pleurocystidia* rare, up to 60 μm long, fusoid-ventricose, hyaline, thin-walled. *Cheilocystidia* subclavate, 25–35 μm long, hyaline, thin-walled. *Pileipellis* a collapsed trichodermium, with cells 3.5–6.3 μm broad, cylindrical to narrowly clavate-subcapitate, smooth, thin-walled, inamyloid, hyaline or with golden yellow content in KOH, with an amorphous, soluble, reddish brown, plasmatic pigment. *Stipitipellis* hyphae hyaline, smooth, thin-walled, with *caulocystidia* 15–40 \times 10–13 μm , subclavate to clavate or short-clavate to oblong or subrectangular. *Clamp connections* absent (sparse, fide Watling & Gregory 1986).

Habit, habitat, and distribution: solitary to gregarious on soil, in the vicinity of *Allocasuarina littoralis* (Salisb.) L.A.S. Johnson, *Eucalyptus camaldulensis* Dehnh., *Eucalyptus* sp., *Acacia* sp. (known mycorrhizal plants), and *Hibbertia riparia* (R.Br. ex DC.) Hoogland; Queensland, Tasmania, Victoria.

Material examined: **Australia: Tasmania** Penguinite, Gunn 1775 (HOLOTYPE: K). **Queensland** Mareeba, Davies Creek National Park, Davies Creek Road, 19 Feb 1992, *Halling* 6837 (ACIAR E4709, PERTH); 17°01'36"S, 145°35'23"E, 670 m, 22 Mar 2007, *Halling* 8958 (BRI, NY); 17°00'35"S, 145°34'56"E, 620 m, 24 Mar 2007, *Halling* 8970 (BRI, NY); Kuranda, Black Mountain Road, 5.3 km N of Kuranda, 16°47'04"S, 145°37'25"E, 450 m, 23 Mar 2007, *Halling* 8962 (BRI, NY); Cooloolo, Mutyi, 17 Sep 1982, *BRIP* 9148 (BRI); 17 Sep 1982, *BRIP* 9150 (BRI); near Rainbow Beach, 17 Sep 1982, *BRIP* 9149 (BRI); Cooloolo National Park, on Fig Tree Point track, 14 April 1966, leg. C. Sandercoe & J. Milne (JECA 86/66–*BRIP* 19814) det. R. Watling (BRI). **Victoria**: Grampians. Victoria Range, Cultivation Creek, near Buandik Camping Ground, 37°15'S, 142°17'E, 1 Nov 1992, *May* 816 (MEL 2030279).

Commentary: This species was first described by Berkeley (1848) based on a collection from Tasmania. The locality was published as 'Penguinite' but this is clearly a typographical error for 'Penguinite' near Launceston, where the collector R.C. Gunn lived and worked for some time. Horak (1980) examined the type specimen, provided some modern details on microscopic features, and transferred the species to *Austroboletus*. Our examination shows that the spores are finely and irregularly rugulose with occasional and scattered, shallowly cratered pits; the rugulosity is continuous over the apex (Fig. 3C–D). In optical section with bright field optics, the spores appear to have peg-like warts and have been described as *Ganoderma*-like (Watling & Gregory, 1986) (Fig. 2C). Watling & Gregory (1986) had examined material from the Cooloolo portion

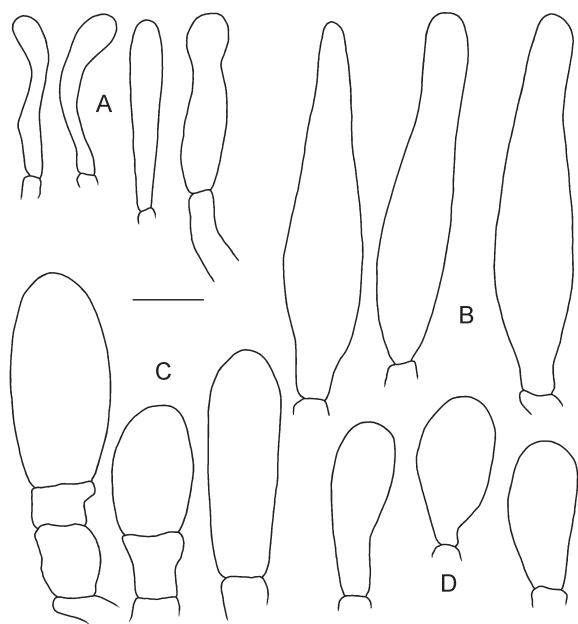


Fig. 4. Microscopic features of *Heimioporus fruticicola* (Halling 8970). **A** Pileipellis elements. **B** Pleurocystidia. **C** Caulocystidia. **D** Cheilocystidia. Scale bar = 10 μ m.

of the Great Sandy National Park, which extended the range beyond the type locality in Tasmania. They were able to provide only some sparse details from the field data lodged with those specimens, but specifics outlining the macromorphology were still lacking. Until now, a habit image has not been available. The dry, basically red colours overall, yellowish hymenophore, a typical lack of cyanescence, non-reticulate (but not unornamented) stipe, and medium stature can be distinguishing macroscopic features in the field. Superficially similar, *Boletellus obscurecoccineus* has more conspicuous scales on the stipe and is of less substantial stature. In *H. fruticicola*, the finely rugulose spore ornamentation with cratered pits appears unique in the boletes (Figs 2C, 3C). In our experience, some *Austroboletus* spores can be rugulose and will become pitted with maturity, but these lack the rim around the pit. Furthermore, the spore colours are different (pinkish vinaceous in *Austroboletus*, olivaceous in *Heimioporus*). References to this species in lists and catalogues have been compiled by May & Wood (1997). A gasteroid form from Victoria (MEL 2264992) is known to have similar spore morphology, but further studies are needed to ascertain its relationship to *H. fruticicola*.

Heimioporus japonicus (Hongo) E. Horak, *Sydowia* **56**: 238. 2004.

Figs 1B, 2A–B, 3A–B, 5

Heimiella japonica Hongo, *J. Jap. Bot.* **44** : 237. 1969.

Boletellus japonicus (Hongo) L.D. Gómez, *Rev. Biol. Trop.* **44**(Suppl. 4): 71. 1996.

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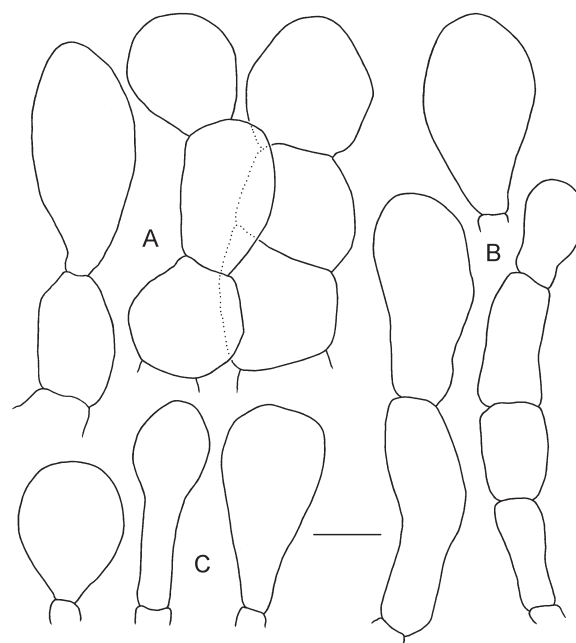


Fig 5. Microscopic features of *Heimioporus japonicus* (Halling 9288). **A** Pileipellis elements. **B** Caulocystidia. **C** Cheilocystidia. Scale bar = 10 μ m.

Pileus 4.5–5 cm broad, plano-convex, dry, finely subvelutinous, deep red to pale red, with some hints of olive at margin from fading; *flesh* pale yellow, unchanging, with mild odour and taste. *Tubes* adnexed, bright yellow to yellow with a hint of pale greenish, unchanging; *pores* 1–2 per mm, yellow, unchanging. *Stipe* 7.5 x 1.5 cm, barely subclavate, straight, dry, dark dull red, pale yellow near base, white at base, coarsely and shallowly lacerate-ridged with a dense red pruina overlaying the ridges, pseudoscabrous; *flesh* pale yellow above, white toward and at base, unchanging.

Basidiospores 10.5–14.7 x 6.3–8.4 μ m ($n = 16$; $x = 12.95 \times 7.78 \mu$ m; $Q = 1.66$), ellipsoid to subamygdaliform, reticulate to alveolate-reticulate, honey brown in KOH. *Basidia* 26–34 x 11–14 μ m clavate, 4-sterigmate, hyaline. *Hymenophoral trama* bilateral, of the *Boletus*-subtype, fleetingly amyloid in Melzer's, hyaline in KOH, with cells 4–9 μ m broad. *Pleurocystidia* absent. *Cheilocystidia* 20–33 x 10–16 μ m, broadly clavate to sphaeropedunculate, smooth, thin-walled. *Pileipellis* a hymeniform epithelium, with cells 7–14(–17) μ m broad, broadly clavate to napiform, sometimes isodiametric, hyaline in KOH, subtended with subpellis elements containing an amorphous, soluble, reddish brown, plasmatic pigment. *Pileus trama* interwoven, with hyphae 5–10 μ m broad, thin-walled, hyaline in KOH, inamyloid. *Stipitipellis* hyphae smooth and thin-walled, with *caulocystidia* 14–30 x 10–20 μ m, clavate to short-clavate to subcylindrical or oblong and subrectangular. *Clamp connections* absent.

Habit, habitat, and distribution: solitary to gregarious; associated with pine and oak in Japan; with *Melaleuca*, *Allocasuarina*, *Eucalyptus*, and *Leptospermum* in Australia; China (associate unknown).

Material examined: **Australia: Queensland** Fraser Island, Kingfisher Bay, 25°23'35.7"S, 153°01'50.7"E, 8 m, 28 Mar 2010, *Halling 9288* (BRI, NY); Cooloola, on King's Bore Walking track, sandy soil (Dune system 4), map ref 9545 IV, Cooloola 105128; 26°01", 153°00', 5 Feb 1980, *D.J. Ross & P. Seguin, JECA 80/30* (BRIP9132, BRI). **China: Yunnan** Kunming market, 29 Jun 2001, *X.H. Wang 1212* (HKAS 3886, NY). **Japan: Shiga** Ôtsu City, Senjô, 31 Aug 1966, *T. Hongo 3294* (HOLOTYPE: TNS-F-237656). Ôtsu, Ishiyama-Terabe, 10 Sep 1958, *Hongo 1858* (PARATYPE: TNS-F-238635). Ôtsu, Senjô, 11 Sep 1981, *T. Hongo 6291* (TNS-F-10187). **Ibaraki** Naka-gun, Naka-mach, Ibaraki Prefectural Forest Park, 28 Aug 1997, *A. Yamada s.n.* (TNS-F-11513). **Shimane** Naka-gun, Asahi-cho, 1 Oct 1985, *E. Nagasawa* (TMI 9144, NY).

Commentary: The material from Cooloola was cited by Watling & Gregory (1986, p. 117) as *Heimiella* sp. and is the earliest collection of the species from Australia. Although Hongo (1969) described the stipe as reticulate, the type, as well as the other material examined, possess the coarsely and shallowly lacerate-ridged stipe surface that is overlain with a dense, red pruina (Fig. 1C). This could be construed as a reticulum of sorts, but is not a reticulum as exemplified by *Boletus edulis* Bull. or *Tylopilus felleus* (Bull.) P. Karst., for example. The finely subvelutinous nature of the pileus surface would hint at the hymeniform configuration of the cells forming that surface. With these surface features and alveolate-reticulate spores, the species is distinctive in the Australian mycota.

The broad geographic distribution and the association with a range of mycorrhizal partners are not unique for *H. japonicus*. Clinal distributions on continental scales and switching of mycorrhizal partners have been documented before (Halling 1989; Mueller & Strack 1992; Halling & Mueller 2002, 2005; Halling *et al.* 2008). Notwithstanding Watling & Gregory's (1986) initial synopsis of the neighboring Cooloola boletes, it is reasonable to expect that our intensive survey for macrofungi on Fraser Island would reveal novel or little known distribution patterns.

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