The Hygrophoropsis Aurantiaca Complex

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THE *HYGROPHOROPSIS AURANTIACA* COMPLEX:

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Hygrophoropsis is a small genus (5 species worldwide *fide* The Dictionary of Fungi, 10th edition), now in its own family *Hygrophoropsidaceae*, near the base of the *Boletales* and thus related to *Tapinella*, *Coniophora* and *Leucogyrophana*. Like these, and unlike most of the *Boletales*, the species are non-ectomycorrhizal, saprotrophic and brown-rotting, shown to be distant from *Paxillaceae* where formerly placed by Singer.

In Europe the genus comprises the very common, widespread and variable False Chanterelle, *H. aurantiaca* plus an unknown number of poorly understood close relatives of *H. aurantiaca* and one other distinctive species *H. olida*, unknown in Britain. This last can be briefly disposed of before reaching the main subject of these notes.

H. olida (Quél. 1878) Métrod
Syn. *H. morganii* (Peck 1882) H. Bigelow
?Syn. *H. rufescens* (Quél. 1875) Singer
Kuyper in FAN3 (1995) used the name *H. morganii* but gave synonymy showing *H. olida* has priority. Moser (1983) also used *H. morganii* and cites illustrations in Marchand (1975), Cetto (1994) and Dahncke & Dahncke (1989). Singer (1982) revived the still earlier name *H. rufescens*; this is used in Courtecuisse and Duhem (1995) but is not mentioned elsewhere(?) and presumably generally considered doubtful.

This is a flesh-pink to pale brick species said to resemble *Hydnum repandum* from above and with a strong, sweet odour like that of *Hebeloma sacchariolens*. It has extremely small, inamyloid spores 3.5–4 x 2.5–3 µm. It prefers upland pine woods and heaths on calcareous soils. It may belong in a separate genus.

There are records of this species in Britain but according to the Checklist specimens at Kew have turned out to be misidentified and are mostly *Clitocybe phyllophila*. Since *H. olida* is known from several European countries I see no reason why it should not occur here.

While *H. aurantiaca* is a familiar species included in most field guides, its close relatives are much less well known and rarely illustrated. In addition to *H. aurantiaca* the Checklist (Legon & Henrici, 2005, referred to hereafter as CBIB) lists *H. fuscosquamula* P.D. Orton. and *H. macrospora* (D.A. Reid) Kuyper. However, Reid (1972) also described *H. aurantiaca* var. *rufa*, subsequently raised to species by Knudsen in *Funga Nordica* (Knudsen & Vesterholt, 2008). This is not distinguished from the type variety in CBIB, but is regarded here as a good species. These three species are the main subject of these notes.

Their treatment is very different in two recent accounts of the genus. FAN3 (followed by CBIB) accepts both *H. fuscosquamula* and *H. macrospora*, but doesn't discuss *H. rufa* at all. Knudsen and Taylor in *Funga Nordica* (Knudsen & Vesterholt, 2008) accept *H. rufa* but do not attempt to separate the pale taxa; they relegate both *H. fuscosquamula* and *H. macrospora*, together with all the names for pale forms of *H. aurantiaca*, to a single unresolved complex (described with larger spores than *H. aurantiaca*) under the name *H. pallida* (Peck) Kreisel "...still unsufficiently known".

H. pallida is based on Peck's *Hygrophorus pallidus* (Peck, 1902) and I seriously doubt that Peck would have interpreted a *Hygrophoropsis* as a waxcap. It was described with a glabrous, hygrophanous and initially lilac cap, hardly fitting any of the species covered here! *H. pallida* is considered by Kuyper (1996) as not validly published and "better regarded as a nomen confusum" and I agree.

Hygrophoropsis aurantiaca (Wulfen) Maire
Typically this species has a bright to pale orange pileus with a felty-tomentose surface (Fig. 1). The lamellae are usually a darker, brighter orange, fork abundantly and have rounded, blunt edges especially when young. The stipe is usually slender and of a darker orange. The spores of the

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Fig. 1. *Hygrophoropsis aurantiaca* in its typical bright yellow-orange form showing the abundantly forked, blunt lamellae. Collected in open grass and herbage in Bushy Park, Middlesex, 19 Nov. 2011. Photo © Geoffrey Kibby.

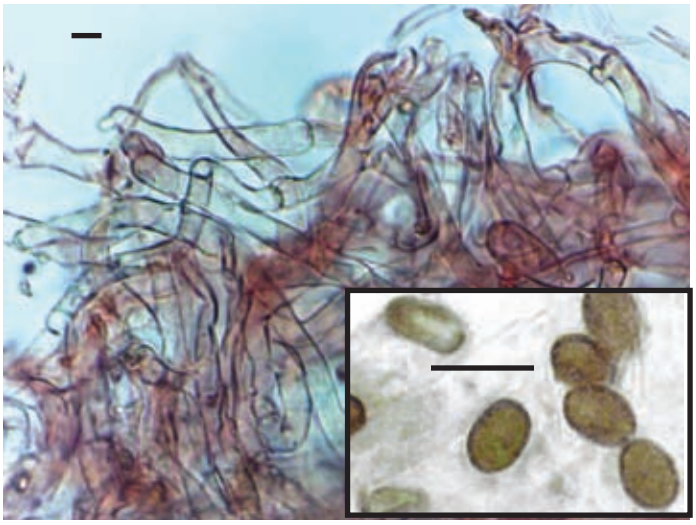


Fig. 2. Tangled cutis of *H. aurantiaca* of more or less undifferentiated hyphae, 6–15 µm wide, stained with Congo Red. Inset: ellipsoid spores in Melzer's Iodine. Scale bars = 10 µm. Photograph © Geoffrey Kibby.

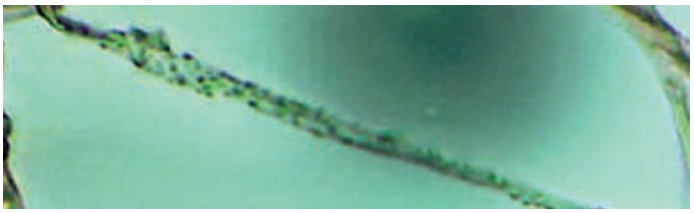


Fig. 3. Mycelial cord of *H. aurantiaca* coated with minute crystals approximately 0.2-0.4 µm across. Photograph © Geoffrey Kibby.

collection illustrated were 5.5–7 x 3–4 µm, broadly ellipsoid to slightly cylindric or even slightly phaseoliform, thin-walled and very weakly dextrinoid (Fig. 2). The hyphae of the pileus formed an interwoven and very irregular cutis with occasional long, emerging hairs. The hyphae were abundantly clamped, smooth and 6–15 µm in diameter (Fig. 2). Some had faint yellow cell contents. Mycelial cords from the stipe base were white and frequently coated in minute crystals, 0.2–0.5 µm across (Fig. 3). *Funga Nordica* (2008) says "...rarely outside forests" but this has not been my experience; it occurs regularly in open heaths, grassland or under bracken, often some distance from trees as well as in mixed woodland.

Hygrophoropsis macrospora (D.A. Reid) Kuyper

On November 6, 2011, Antony Burnham and I found and photographed a beautiful, ivory-capped *Hygrophoropsis* in some

Fig. 4. *H. macrospora* with entirely pallid pileus, lamellae and stipe growing in a wet, boggy habitat with *Juncus* on the edge of a pond on Wimbledon Common, November 2011. Photograph © Geoffrey Kibby.

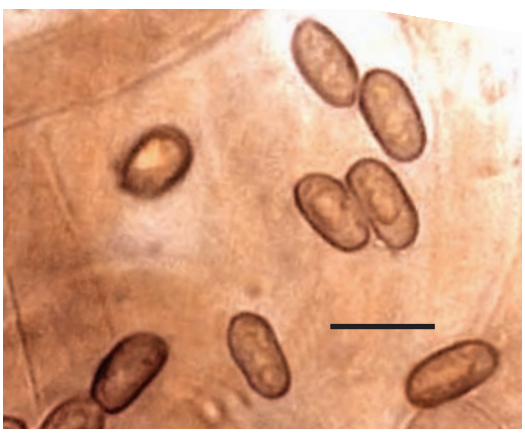


Fig. 5. *Hygrophoropsis macrospora*, spores from the collection in Fig. 4 in Melzer's iodine.
Scale bar = 10 µm. Photograph © Geoffrey Kibby.

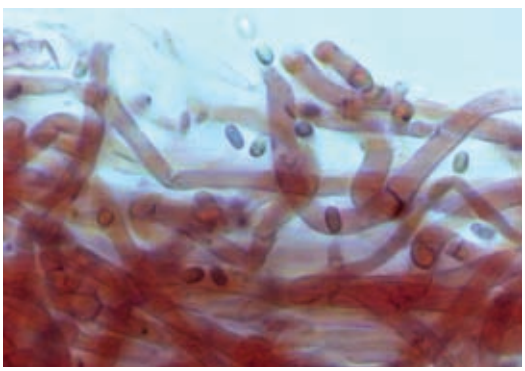


Fig. 6. Tangled cuticular hyphae, in Congo Red. Photograph © Geoffrey Kibby.

quantity, growing in *Sphagnum* and grass amidst *Juncus* stems on the edge of a pond on Wimbledon Common, SW London (Fig. 4). The fruitbodies were striking for the overall cream-ivory tones of pileus, lamellae and stipe, throughout all stages of their growth. Subsequent examination of the spores showed them to be cylindric-ellipsoid to slightly phaseoliform, 7–10 x 3.5–4.5 µm (Q = 2–2.2) and strongly dextrinoid in Melzer's Iodine solution (Fig. 5), broadly agreeing with the original description by Derek Reid (1972) although not reaching the extreme lengths he quoted. The hyphae of the pileus formed an interwoven and very irregular cutis, were smooth, often clamped and 8–15 µm in diameter (Fig. 6).

It was disconcerting to find that in *Funga Nordica H. macrospora* is listed in the synonymy of *H. pallida*, for which differently shaped spores are illustrated. They are broader, and rather ovate-ellipsoid and the size range quoted, 6–9(10) x 4–5 µm (Q = 1.5–1.8), differs from that of Reid whose description is quoted here:

"There is in Britain another, hitherto unnamed, variety of *H. aurantiaca* which is distinguished in having much larger, dextrinoid spores, measuring 8.0–11.0 (–13.0) x 3.0–4.5 (–5.0) µm [Q = 2.4–2.6]. Macroscopically this taxon is very like var. *aurantiaca*; it has a creamy-tan cap with felty-fibrillose surface, yellowish forked gills, and

a stipe which is concolorous with the pileus but becomes darker on handling. Apart from the larger spores the microcharacters agree with those of the var. *aurantiaca*. This new variety I propose to call var. *macrospora"*.

Examination of Reid's type revealed spores 8–11 x 4–4.5 agreeing well with his measurements. I was unable to find the larger spores up to 13 µm which he included however (Fig. 7), in the small fragment I examined.

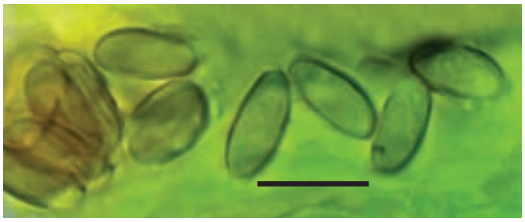


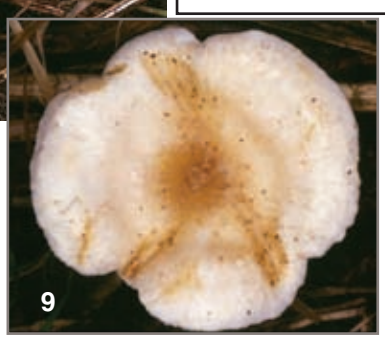
Fig. 7. Spores from the type of *H. aurantiaca* var. *macrospora* D.A. Reid. Scale bar = 10 µm. Photograph courtesy of Royal Botanic Gardens, Kew.

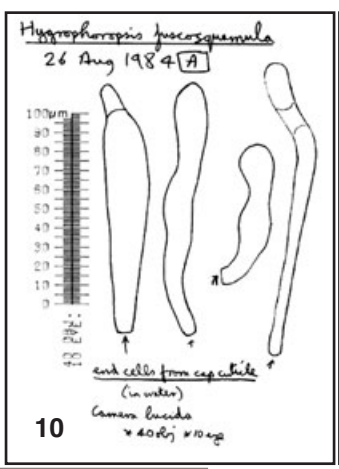
H. pallida as described in *Funga Nordica* is plainly a mixture of several pale taxa. The synonymy proposed there is not accepted here.

Hygrophoropsis fuscosquamula P.D. Orton

Described by Peter Orton (1962) this is a somewhat problematic and rarely recorded species. It is described as very pale with white to pale ochraceous lamellae very much like *H. macrospora* and, like that species, it grows with *Juncus* in wet habitats (Figs 8–10). The main difference is in the dark brownish hairs which he describes as scattered over the pileus surface and which have broader cylindric-clavate end cells 12–16 µm across. The spores are shorter also: 6–8 x 3.5–4.5 µm. It is possible that the two species are one and the same and that the spore size is variable, although it is unusual to have such a wide variation in spore length. Should the two species prove synonymous then *H. fuscosquamula* would have priority; certainly they are very similar. But until some other evidence appears, either from a detailed morphological study or perhaps DNA analysis, I retain both species.

Illustrated in Figs 8–10 is a collection by Malcom Storey which agrees well with Orton's concept. The spores were 7.6–8.3(-9) x 4.2–4.7 µm and matched those of the type very closely. Malcolm describes the cap hyphae as "*with inflated end cells with basal clamps and very pale greyish contents (vacuolar pigment), end cells cylindric to pointed-clavate, often flexuose and/or septate, variable in size and shape, 75–170* ***x*** *12–22 µm*".





Figs 8–10. A collection of *H. fuscosquamula*.
Fig. 8. The pale lamellae.
Fig. 9. The darker hairs on the pileus surface.
Fig. 10. Cuticular hyphae and ellipsoid to slightly cylindric spores, 7.6–8.3(-9) x 4.2–4.7 µm .
North Wiltshire, 26 Aug. 1984. Photographs and drawings © Malcolm Storey.

Other pale varieties

A number of possible pale varieties of *H. aurantiaca* have been published, all rather inadequately described, including:

Clitocybe aurantiaca* var. *albida (Gillet) Rea.

Clitocybe aurantiaca* var. *lactea (Fr.) Rea.

Cantharellus aurantiacus* var. *pallidus Cooke (1888) (Fig. 11).

The var. *albida* had white lamellae while var. *lactea* was entirely white, and var. *pallidus* was described as having pallid lamellae. Some of these undoubtedly refer to either *H. macrospora* or *H. fuscosquamula* as described here (the Cooke plate 1057 (1104)) shows a spore size of 10 x 5 µm which would match *H. macrospora* but otherwise looks too dark, more like *H. fuscosquamula*), but there is little doubt that pale forms of the ordinary *H. aurantiaca* also occur and there is much confusion over these pale taxa.

Fig. 11. *Cantharellus aurantiacus* var. *pallidus* as illustrated by Cooke. Photograph courtesy of Royal Botanic Gardens, Kew.

Hygrophoropsis rufa (D.A. Reid) Knudsen

A week after the collection of *H. macrospora* described above, Ted Brown collected a dark, tan-orange species with darker reddish brown hairs covering the pileus and stipe and pale salmon-cream lamellae (Fig. 12).

Examination of the pileus cuticle in water mounts revealed it to be densely interwoven with emergent hyphae of three distinct types forming a distinct trichoderm (Figs 13 & 14). The dominant hyphae were large, cylindric to cylindric-clavate, thick-walled with faint yellowish walls, often with irregular, wavy outlines and 10–15 µm across. Mixed with these were fewer, more slender cylindric-clavate cells whose end cells contained densely granular golden-brown

Fig. 12. *H. rufa* with a covering of dark brown hairs on the pileus and stipe. Note that the lamellae in this collection were pale cream-salmon. Collected by Ted Brown, Surrey, Sutton & Morden cemetery, 8 Nov. 2011, in grass on a conifer stump. Note the sulphur yellow mycelium at the base of the stipe (arrowed). Photograph © Geoffrey Kibby.

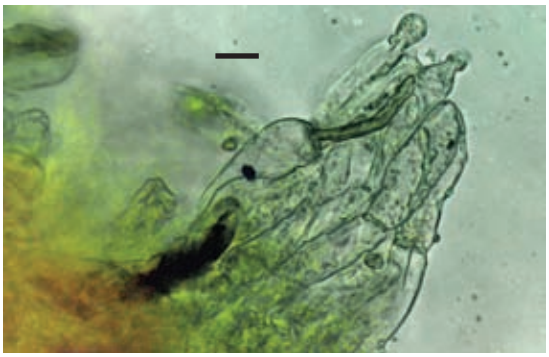


Fig. 13. Tuft of trichodermal hyphae from cuticle of *H. rufa* shown in Fig. 12. Scale bar = 10 µm. Photograph © Geoffrey Kibby.

Fig. 14. End cells of trichodermal hyphae from *H. rufa* showing three distinct types: broad, thick-walled and hyaline; narrower, densely granular and golden-brown; long, filiform and hyaline. Scale bar = 10 µm. Drawing © Geoffrey Kibby.

Fig. 15. A much paler collection of *H. rufa* but still with brown hairs on the pileus (see the small cap at bottom) and with copious sulphur-yellow mycelial cords. Kew Gardens on woodchips, Dec 6, 2011. Coll. Alick Henrici. Photograph © Geoffrey Kibby.

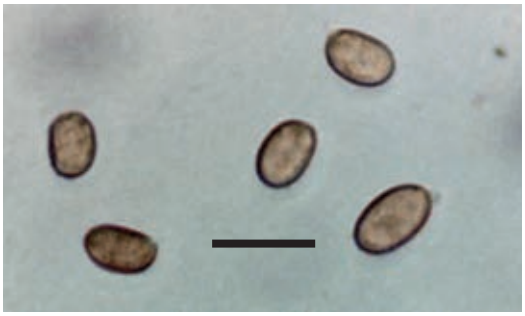


Fig. 16. Ellipsoid spores of the *H. rufa* collection shown in Fig. 15. Scale bar = 10 µm. Photograph © Geoffrey Kibby.

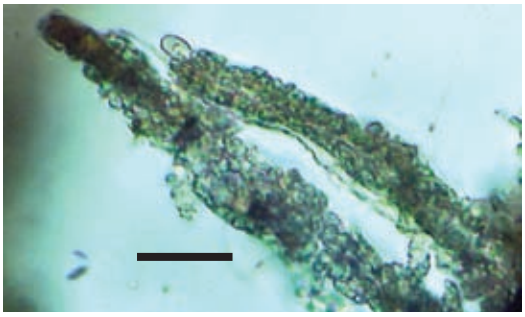


Fig. 17. Densely encrusted yellow mycelial cord from stipe base of the *H. rufa* collection shown in Fig. 15, with crystals 1-3 µm across. Scale bar = 10 µm. Photograph © Geoffrey Kibby.

contents, 5–7 µm across. And finally, more rarely, extremely slender, filiform, hyaline hyphae 2–3 µm across arising from much broader cylindric cells. This arrangement of cell types was in strong contrast to those of ordinary *H. aurantiaca* examined, where the cuticle was formed of a tangled cutis of rather uniform nature (see Fig. 2 above). It is assumed that the granular, golden-brown hyphae were those observed as brown hairs on the pileus surface.

The spores were 6–7 x 3–4(-4.5) µm, broadly ellipsoid, thick-walled and strongly but very erratically dextrinoid with about 30% hardly reacting at all.

These characters agreed broadly with *H. aurantiaca* var. *rufa* as described by Reid (1972). The fruitbodies were found growing with conifers on an old stump which seems to be the preferred habitat for this species.

On December 6 Alick Henrici made a large collection of a robust *Hygrophoropsis* found on woodchip mulch in Kew Gardens (Fig. 15) that I believe also to be *H. rufa*. This collection was paler than that shown in Fig. 12 but like that collection had a distinct, if faint, covering of brownish hairs on the cap and similar cuticle structure. It was also noticeable for the lamellae which in some of the fruitbodies were very pale cream, in others pale salmon-orange. The fruitbodies were also characterised by the presence of coarse, sulphur-yellow mycelial cords at the stem base and finally by a strong, penetrating odour. The latter is difficult to describe but had a fresh, ozone-like character (interestingly, it was identical to the smell of the flowers of a commonly grown orchid, *Oncidium ornithorhynchum*); it was described by one mycologist as "like photocopiers"!

The spores of this collection were 6–7(-8) x (3-) 3.5–4 µm, broadly ellipsoid to slightly cylindric or occasionally phaseoliform, strongly dextrinoid with a small percentage non- or hardly dextrinoid (Fig. 16). The sulphur-yellow mycelial cords at the stipe base proved to consist of dense bundles of narrow hyphae each 2–4 µm in width. Many of these hyphae were densely encrusted with a crystalline coating (Fig. 17), often with large individual cuboid crystals 1–3 µm across. I have been unable to trace any prior reference to these in *Hygrophoropsis* but very similar structures are known to be present in the mycelium of *Paxillus* species and are used by some authors to help distinguish species, the crystals said to be of different sizes in different species (Hahn & Agerer, 1999).

Fig. 18. Probable *H. rufa* with deep orange lamellae and dark brown, velvety pileus and stipe. Germany, Ulm, Eggingen. Photograph © H. Krisp.

Figure 18 illustrates another collection originally assigned to *H. aurantiaca* but quite clearly belongs to *H. rufa* (but not examined personally), with much darker, intensely orange lamellae as well as denser brown hairs on the pileus. A look at the published and online photographs purporting to be *H. rufa* shows a wide variation in the intensity of the dark brown pileal hairs and lamellae colour. A similar dark collection found in Kent is illustrated on the back cover. I suggest that this variation in colour is typical of this species (and perhaps of all the strongly pigmented *Hygrophoropsis* species?), possibly depending on the amount of exposure to light or other factors. Therefore colour may be a poor character to use in determining the different species; instead emphasis should be placed on spore size and cuticle structure.

Although often regarded as a variety of *H. aurantiaca* (e.g. in CBIB) the differences in macroscopic and microscopic characters

combined with the habitat preference seem to warrant specific status and I follow Knudsen (Knudsen & Vesterholt, 2008) in treating *H. rufa* as a distinct species.

I would urge anyone collecting these or other interesting forms of *Hygrophoropsis* to make detailed measurements of spores, noting their size and shape as well as iodine reactions and to examine and record the cap cuticle structure and nature of the basal rhizomorphs.

Hopefully some preliminary molecular work undertaken by Tuula Niskanen and her team in Sweden (pers. comm.) or by some other future study will throw further light on these confusing species.

Provisional Key to the species of *Hygrophoropsis* (= not British)**

1. Spores very small, 3.5–4 x 2.5–3 µm, pileus pale pinkish-brick to salmon; with strong sweet, aromatic odour .....***H. olida*****
1. Spores much larger.....2

2. Pileus, lamellae and stipe all very pale, white to cream, growing in wet areas, often with *Juncus*.....3
2. Pileus and stipe much stronger in colour, yellow, orange, dark brown; lamellae from pale cream-orange to vivid orange, habitats various.....4

3. Spores cylindric-ellipsoid, 7–11(13) x 3–4.5(-5) µm, strongly dextrinoid; pileus, stipe and gills uniformly pale cream to pale yellowish-cream .....***H. macrospora***
3. Spores shorter, 6–8 x 3.5–4.5 µm, dextrinoid; pileus pale cream with darker brown hairs or squamules scattered over the surface; gills white to pale ochre....***H. fuscosquamula***

4. Pileipellis a tangled cutis of mainly hyaline to faintly yellow hyphae 7–15 µm broad; pileus pale cream-orange to bright yellow-orange or orange, surface felty; lamellae pale to dark orange; spores 5.5–7 x 3–4 µm, ellipsoid to distinctly cylindric, weakly dextrinoid ; in mixed woods, open heaths or grassland .....***H. aurantiaca***
4. Pileipellis with trichodermal tufts of erect hyphae, some broad, thick-walled and hyaline, some with granular golden-brown contents, others filiform; pileus with dark brown velvety hairs faintly to densely covering a paler, more orange ground; lamellae from pale cream-salmon to deep orange; spores 6–7 x 3–4(-4.5) µm, ellipsoid to slightly cylindric, strongly dextrinoid; usually on or around conifer stumps or on wood chips.....***H. rufa***

Acknowledgments

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