HYPERPHYSCIA

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Hyperphyscia Müll.Arg., *Bull. Herb. Boissier* 2, App. 1: 10 (1894).

Type: *H. adglutinata* (Flörke) H.Mayrhofer & Poelt

Physciopsis M.Choisy, *Bull. Mens. Soc. Linn. Lyon* 19: 20 (1950).

Hyperphyscia is distinguished from other small-foliose Physciaceae with a thalline proper exciple by its filiform rather than bacilliform pycnoconidia and by the absence of atranorin in the upper cortex. Whether the filiform pycnoconidia can be maintained as a diagnostic character remains to be determined, given the demonstrated polyphyletic nature of *Amandinea* (Wedin *et al*., 2002) which also possesses filiform propagules. However, all species in *Hyperphyscia* have small brown to grey thalli without secondary substances in the upper cortex. The presence of 1-septate and 3-septate spores within the genus has been pointed out by Moberg (1987) and Scutari (1997) as a possible indicator of heterogeneity, although *Buellia* and *Rinodina* also exhibit this variation. Neither of those genera, however, is monophyletic (Grube & Arup, 2000).

Secondary chemistry is uniformly simple, with the orange pigment skyrin the only compound present. The upper cortex of *Hyperphyscia* is K–, whereas the small-lobed genera *Dirinaria* and *Physcia* are invariably K+, as are many species of *Pyxine*. The thallus lacks marginal cilia and is never yellow-green from usnic acid, further distinguishing it from some small Parmeliaceae.

Hyperphyscia has been recognised as a taxonomic entity for many years, although it was known as *Physciopsis* M.Choisy (Choisy, 1950; Poelt, 1965; Hafellner *et al.*, 1979) for some time. Poelt (1965) employed filiform pycnospores to differentiate *Physciopsis* from *Physconia*, but the usefulness of that character at genus level has been questioned by Scheidegger *et al.* (2001). However, molecular studies (Helms & Friedl, 2003; Cubero *et al.*, 2004) have confirmed that *H. adglutinata* is separated from other foliose taxa in the Physciaceae (including *Physconia*), and it appears to represent an independent evolution of the foliose growth form from crustose origins. Only one species of *Hyperphyscia* was included in the molecular analyses, and no conclusions can be drawn on the homogeneity of the genus based on those studies (Helms & Friedl, 2003).

Two species, *H. adglutinata* and *H. syncolla*, were reported from South Australia by Filson & Rogers (1977) as *Physciopsis eleiana* (Sm.) Poelt and *P. syncolla* (Tuck.) Poelt, respectively. Moberg (1997) recorded *H. pandani* from New South Wales, and Elix (2007) reported *H. pruinosa* from Queensland and New South Wales.

The relationship between the lichens of Australia and Africa, especially the tropical and subtropical elements (Rogers, 1992), made the study by Moberg (1987) of the East African species the obvious starting point for the current investigation. Investigations by Scutari (1991, 1997) on the South American representatives provided further insight into the genus.

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Key

1 Thallus lacking soredia and isidia ..... **5. H. syncolla**
1: Thallus with soredia or isidia 2
2 Thallus isidiate ..... **2. H. isidiata**
2: Thallus sorediate 3

3 Medulla orange to orange-red or very dark brown, at least beneath soralia or pycnidia ..... **3. H. pandani**
3: Medulla white 4

4 Soralia marginal ..... **4. H. pruinosa**
4: Soralia laminal ..... **1. H. adglutinata**

1. Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt, *in* Hafellner *et al.*, *Herzogia* 5: 63 (1979)

Lecanora adglutinata Flörke, *Deutsch. Lich.* 7 (1819); *Physciopsis adglutinata* (Flörke) M.Choisy, *Bull. Mens. Soc. Linn. Lyon* 19: 20 (1950)

Physciopis eleiana (Sm.) Poelt, *sensu* Filson & Rogers (1979: 150).

Fig. 1A

Thallus foliose, to 2 cm diam., often merging with other thalli, lacking a hypothallus, closely adnate; lobes 0.2–0.5 mm wide, broadening to the tips, often crowded; upper cortex grey-green to olive or brown, sorediate, not isidiate, not or sparingly pruinose. Soralia laminal, maculiform or crateriform or spreading to the margins, occasionally the upper cortex exfoliating. Medulla white. Lower cortex indistinct, lacking rhizines, pale at the margins, darker near the centre. Apothecia uncommon, c. 1 mm diam.; thalline margin present. Ascospores 8 per ascus, 1-septate, 15–20 × 7–8 µm; walls grey-brown.

On bark or wood, rarely on brick; in S.A., Qld, N.S.W., Vic. and Tas.

S.A.: High Eden Rd, 6 km NW of Springton, *J.A.Elix 41938* (CANB); Walkerville, *R.W.Rogers 11276* (BRI). Qld: Miriam, *R.W.Rogers 11812* (BRI); d'Aguilar Hwy, c. 2 km NW of Yarraman, *R.W.Rogers 11788, 11791* (BRI); Margate, *R.W.Rogers s.n.* (BRI). N.S.W.: Tenterfield, *R.W.Rogers 11996* (BRI); Kurnell, Botany Bay, *J.A.Elix 2908* (CANB); Bermagui Trig Stn, *J.A.Elix 28840* (CANB). Vic.: Botanic Gardens, Hamilton, W.H.Ewers 671, 673 (MEL); Heidelberg, 29 Dec. 1899, *R.A.Bastow* (MEL); Manuka Drive, Warrnambool, *R.G.Lock*, 6 Dec. 1986 (MEL). Tas.: Babel Is., Bass Str., *J.S.Whinray s.n.* (MEL); Low Head, *G.Kantvilas 971/01* (HO); St Georges Square, Launceston, *G.Kantvilas 261/02* (HO).

Hyperphyscia adglutinata is widespread in eastern Australia south of the Tropic of Capricorn, but it has not been confirmed from Western Australia. This lichen is common in urban areas in south-eastern Australia along with other Physciaceae, notably *Pyxine subcinerea* and *Dirinaria applanata*, but it certainly not restricted to such habitats, also occurring in areas that are far-removed from cities. It grows on a diverse range of bark types, and it has been collected from a brick wall in south-eastern Queensland.

The species is often cryptic, occurring as very fine, closely adnate lobes on bark that is often similar in colour to the thallus or on which the species is so densely developed that it can be mistaken for the bark from a distance of a few metres. It can be distinguished from other species by its white cortex and laminal punctiform soralia. *Hyperphyscia adglutinata* is very variable in lobe width, degree of adnation to the substratum and development of soralia. Soralia usually begin as small laminal vesicles that burst open (termed 'maculiform' by Moberg, 1986), and these can resemble minute isidia. The vesicles can be so dense that the developing soralia cover the centre of the thallus, or they can remain quite discrete. In southern Australia a few specimens are decorticate, and soredia develop from the exposed medulla as well as from vesicles. The soralia sometimes appear as small craters in the upper cortex, but these are often accompanied by vesicular soralia, precluding the identification of specimens by means of this character.

The wide distribution in diverse habitats combined with variation in appearance suggest that *H. adglutinata* is a species complex, but all attempts to differentiate morphological groups have failed, as intermediate forms or thalli showing different developments on different lobes were invariably found. The absence of secondary chemistry further complicates identification, and perhaps only molecular studies can confirm whether the material currently included in *H. adglutinata* represents more than one species.

Reports of this species from Western Australia and northern Queensland either cannot be confirmed or clearly indicate other genera of Physciaceae.

2. Hyperphyscia isidiata Moberg, *Nordic J. Bot.* 7: 722 (1987)

Fig. 1D

Thallus foliose, to 2 cm diam., lacking a hypothallus, closely adnate; lobes to 0.5 mm wide, broadening to the tips, often crowded; upper cortex grey-green to olive or brown, somewhat pruinose, isidiate. Isidia simple or coralloid-branched, crowded. Medulla white. Undersurface dark, with an indistinct lower cortex, lacking rhizines, pale at the margins, darker near the centre. Apothecia uncommon, c. 0.5 mm diam.; thalline margin present. Ascospores 8 per ascus, 1-septate, 14–18 × 7–10 µm; walls grey-brown.

Grows on bark in N.S.W.; reported here for the first time from Australia.

N.S.W.: Conapaira South S.F., 13 km SSW of Rankin Springs, on *Callitris, J.A.Elix 25393* (CANB); Mountain Ck, Jimbaroo S.F., 14 km NNE of Rankin Springs, on *Callitris, J.A.Elix 25288* (CANB).

The highly distinctive *H. isidiata* has simple or coralloid isidia, and although this is the only truly isidiate Australian species, the minute laminal vesicles of *H. adglutinata* can be mistaken for isidia before they erupt and develop soredia. Both of the Australian specimens examined came from central-western New South Wales and had rather poorly developed thalli. Elsewhere, this species is known from East Africa, Angola and Costa Rica.

3. Hyperphyscia pandani (H.Magn.) Moberg, *Nordic J. Bot.* 7: 722 (1987)

Physcia pandani H.Magn., *in* Magnusson & Zahlbruckner, *Ark. Bot.* 32(2): 5 (1945).

Fig. 1B

Thallus foliose, to 2 cm diam., apparently lacking a hypothallus, closely adnate to the substratum; lobes 0.2–0.5 mm wide, often crowded; upper cortex grey-green to olive or brown, sorediate, not isidiate, not or very sparingly pruinose. Soralia laminal, maculiform, initially subdigitate, often dense and ±continuous; soredia occasionally orange. Medulla orange to red (skyrin) or white with an orange band in the lower medulla, or the medulla white with the orange pigmentation restricted to areas beneath soralia. Lower cortex indistinct or not apparent. Apothecia rare, to 0.5 mm diam.; thalline margin well developed. Ascospores 8 per ascus, 1-septate, brown, 15–18 × 7–8 µm, with thickened walls.

On bark in Qld and N.S.W.

Qld: Lowmead, *R.W.Rogers 11815* (BRI); Childers, *R.W.Rogers 11874* (BRI); c. 1 km S of Coonarr Beach, *R.W.Rogers 11034* (BRI); 25 km E of Jandowae, *R.W.Rogers & J.Hafellner 8132* (BRI); Brookes St, The Valley, *R.W.Rogers & C.Scarlett 7435* (BRI); Burleigh Heads Esplanade, *R.W.Rogers 11241* (BRI). N.S.W.: Stuarts Pt, 32 km NNE of Kempsey, R.*Moberg & B.Owe-Larson A89* (CANB); Royal Botanic Gardens, Sydney, *V.Stajsic 2899* (MEL).

Hyperphyscia pandani is characterised by a deep orange to red pigment (skyrin) in the medulla and by the presence of soralia. The type material from the Hawaiian Islands is very closely adnate to the substratum, has a very thin thallus with widely spaced lobes and a distinct black hypothallus. No Australian material is so closely attached or as thin, and the black hypothallus is not seen.

While the species is very variable in its pigmentation, lobe width and adnation to the substratum, it has not been possible to recognise discrete taxa within this assemblage. However, some specimens in which the soralia are well developed and eroded have a very distinctive appearance with bright orange centres visible in the soralia that are occasionally substipitate. However, an single soralium of this type can be found on a thallus having all other soralia lacking orange centres. Apart from pigmentation, *H. pandani* resembles the similarly variable *H. adglutinata*, in Australia it is rarely found without *H. adglutinata* in close proximity, and in many of the collections examined *H. pandani* forms the minority of a mixed *H. adglutinata*/*H. pandani* population.

Hyperphyscia pandani is restricted to the eastern subtropical coastal belt in Australia, where it is known from mangroves, and on palms and other trees. The species is widely distributed in tropical/subtropical areas including the Hawaiian Islands, East Africa and the Americas.

Hyperphyscia pandani might be expected to occur in subtropical Western Australia, but there are no records from that region.

4. Hyperphyscia pruinosa Moberg, *Nordic J. Bot.* 7: 723 (1987)

Fig. 1C

Thallus foliose, to 2 cm diameter, lacking a hypothallus, adnate to closely adnate on the substratum; lobes to 0.5 mm wide, narrow to the tips, often crowded and subcrustose in the centre, convex; upper cortex grey-green to olive, or brown or black, sorediate, not isidiate, often white-pruinose (especially near the tips). Soralia on older parts of the lobes, initially marginal and occasionally spreading laterally onto the upper surface. Medulla white. Apothecia uncommon, to 1 mm diam.; thalline margin well developed. Ascospores 8 per ascus, 1-septate, thick-walled, brown (15–) 17 (–19) × 7–8 µm.

Grows on bark in W.A., N.T., S.A., Qld and N.S.W.

W.A.: 3 km NNE of Bullen Well, Little Sandy Desert, *R.J.Cranfield 18278* (PERTH). N.T.: near Southern Cross Bore, Owen Springs Reserve, *G.Kantvilas 275/05* (HO). S.A.: Everard Ra., 3 June 1891, *R.Helms* (MEL); 30 km W of Cockburn, *R.W.Rogers 11971* (BRI); Koonamore Vegetation Reserve, *R.W.Rogers 1639* (HO); Walkerville, Adelaide, *R.W.Rogers 11275* (BRI). Qld: 4 km N of Bataria HS, 55 km SE Winton, *V.J.Neldner 2540a, b* (BRI); 10 km E of Bollon, *R.W.Rogers 11987* (BRI); c. 40 km E of Goondiwindi, *R.W.Rogers 11986* (BRI). N.S.W.: Narrabri, *R.W.Rogers 11978* (BRI); c. 20 km S of Quirindi, *R.W.Rogers 11977* (BRI); Lachlan S.F., 15 km NW of Rankins Springs, *J.A.Elix 23101* (*Lich. Australas. Exsicc.* No. 210) (CANB).

Eumarginal soralia (*sensu* Moberg, 1986) originate at the lobe margin rather than on the upper or lower surface, and this character separates *H. pruinosa* from other Australian species. Australian material is far less pruinose than the East African type and, in some cases, is almost epruinose. However, the continuity of other attributes leaves little doubt that the material is conspecific. Specimens from the most arid regions are often heavily fertile and, if soralia are few, they can resemble *H. syncolla* with which *H. pruinosa* is occasionally found. *Hyperphyscia pruinosa* can also occur with *H. adglutinata*.

In Australia, *H. pruinosa* largely inhabits a band-like zone in arid to semi-arid to Mediterranean-type climates across the south-east and in some more equable areas in New South Wales. It tends to occupy drier conditions than *H. adglutinata*, but it is not as restricted as *H. syncolla* to such areas. *Hyperphyscia pruinosa* occurs on the bark of native and introduced trees.

5. Hyperphyscia syncolla (Tuck. ex Nyl.) Kalb, *Lich. Neotrop.* 6: 11 (1983)

Physcia syncolla Tuck. ex Nyl., *Syn. Meth. Lich.* 1(1):428 (1858); *Physciospis syncolla* (Tuck. ex Nyl.) Poelt, *Nova Hedwigia* 9: 30 (1965).

Fig. 1E

Thallus foliose, to 4 cm diam., lacking a hypothallus, adnate; lobes to 2 mm wide; upper cortex olive or brown, lacking soredia, isidia and pruina. Medulla white. Lower cortex indistinct, lacking rhizines, pale at the margins, darker near the centre. Apothecia common, to 1.2 mm diam.; thalline margin well developed. Ascospores 8 per ascus, 1-septate, thick-walled, brown, (15–) 17 (–20) × 7–8 µm.

Grows on bark in W.A., N.T., S.A., Qld and N.S.W.

W.A.: Nookawarra Stn, *R.J.Cranfield 5484* (PERTH); 30 km E of Kitchener, E of Kalgoorlie, *R.D.Royce 213* (PERTH); Boulder, 4 km SW of Western Mining Corp. nickel smelter, 25 June 1976, *C.V.Malcom & P.G.Collins* (PERTH). N.T.: Tylers Pass, 5 km S of Haast Bluff, MacDonnell Ra., *J.A.Elix 1271 & L.A.Craven* (CANB). S.A.: N of Ernabella Rd, 4 miles [c. 6.5 km] W of Kenmore Park HS, Musgrave Ra., *R.B.Filson 15868* (MEL); Stuart Hwy, 48 km S of Pimba, *J.A.Elix 11032 & L.A.Craven* (CANB); Koonamore Vegetation Reserve, *R.W.Rogers 1939* (BRI, HO). Qld: 26 km N of Quilpie, May 1985, *V.J.Neldner & T.D.Stanley* (BRI); Balonne Hwy, 20 km E of Cunnamulla, *R.W.Rogers 11970* (BRI). N.S.W.: Hay, 16 Nov. 2007, *R.W.Rogers* (BRI); Barrier Hwy, 10 km SE of Wilcannia, *R.W.Rogers 11969* (BRI); Mountain Ck, Jimbaroo S.F., 14 km NNE of Rankin Springs, *J.A.Elix 25283* (CANB).

This lichen is usually abundantly fertile, and it is unlikely to be confused with other Australian *Hyperphyscia* species, although a careful search for marginal soralia is required in order to exclude *H. pruinosa*. *Dirinaria minuta* Kalb, which occurs on rock in the wet-dry tropics of northern Australia, is somewhat similar, but the upper cortex contains atranorin (K+ yellow). *Hyperphyscia syncolla* usually has considerably broader lobes than other species, numerous large apothecia, and it lacks soredia and isidia. It is widespread on bark, especially *Acacia aneura* (mulga) in semi-arid and arid regions in a band across the southern half of Australia. This lichen usually occupies habitats that are drier than those of other *Hyperphyscia* species.

Discussion

Species of *Hyperphyscia* often grow together, and they can be found as mixed collections in most herbaria. They also occur with other small-foliose Physciaceae, including species of *Physcia*, *Dirinaria* and *Pyxine*. *Hyperphyscia adglutinata* and *H. pandani* are most common in urban areas, occurring in garden and on roadsides, in locations where air quality is likely to be low. *Hyperphyscia pruinosa* is also found in urban areas, but less commonly so, perhaps because of its preference for drier habitats than *H. adglutinata* and *H. pandani*, and because most urban areas in Australia are in comparatively high-rainfall, coastal regions. Only a single collection of the exclusively arid and semi-arid *H. syncolla* was made within a town, all specimens coming from the bark of native trees and shrubs, as do those of *H. pruinosa*. In contrast, *H. adglutinata* and *H. pandani* grow on a broad range of native and introduced trees and shrubs.

All but one of the numerous Australian *Hyperphyscia* specimens examined were collected from south of the Tropic of Carpricorn; indeed the exception, a specimen *H. adglutinata*, came from only a few kilometres north of the tropic in eastern Queensland. *Hyperphyscia adglutinata* is known from the montane tropics of Thailand (Saipunkaew *et al.*, 2007) and South America (Scutari, 1997), and a number of endemic species occur in tropical South America.

Among the Australian taxa, *H. pandani* is the one most obviously associated with the wettest regions and areas in which rain falls year-round. In contrast, *H. adglutinata* has a much broader range, and it penetrates parts of southern Australia where rainfall is distinctly seasonal and where the dry season can be very hot. *Hyperphyscia pruinosa* occurs in areas that are at least seasonally dry or distinctly arid. *Hyperphyscia syncolla*, an arid zone species, has been collected in some of the driest parts of Australia, and the two known collections of *H. isidiata* came from a moderately dry area of New South Wales.

While the distribution of *Hyperphyscia* in eastern Australia is broadly consistent with the global pattern for the genus, its comparatively poor representation in Western Australia is remarkable, with only two arid zone species being present. The subtropical coastal strip of Western Australia, although drier than its equivalent in Queensland, should to support species of *Hyperphyscia*, but none have been collected there. Moreover, *H. adglutinata*, which occurs in South Australia, might be expected in the south-west of Western Australia, but it has not been seen. This disparity is further reinforced by the distribution patterns of other physciaceous genera, such as *Pyxine* and *Dirinaria* (Elix, 2009).

A possible explanation for the comparatively low species diversity in Western Australia and the absence of many lichens expected to occur there on climatic grounds involves a reduction in diversity during a series of arid periods in the Pleistocene, the most severe of which occurred approximately 17,000 years ago (Crisp *et al.*, 2001). At that time, *Hyperphyscia* species once present across Australia, were unable to survive in the comparatively flat and drier west, while cooler montane refugia were available along the east coast. A cooling of the climate in the last 15,000 years has, presumably, allowed the spread of *Hyperphyscia* from the eastern refugia, but not to the extent that Western Australia could be repopulated across more than 1,000 km of arid southern coastline and against the prevailing westerly winds.

The two Australian collections of *H. isidiata* came from a small and unremarkable area of central-western New South Wales, sites that are climatically similar to those occupied by this species in Kenya (Moberg, 1987). Given the large number of *Hyperphyscia* collections

examined, it is unlikely that the distribution of *H. isidiata* is simply the result of accidental collection of a species that is rare but widely distributed within Australia.

All five Australian species are also known from Africa (Moberg, 1987), a commonality that is consistent with observations on the broader similarity of the Australian and African lichen floras (Rogers & Stevens, 1981). It might also be expected that species would be shared between New Zealand and southern Australia, especially Tasmania. While this is true of *H. adglutinata*, *H. plinthiza* (Nyl.) Müll.Arg., a distinctive lichen that forms large thalli, is endemic to New Zealand.

Figure 1. A, *Hyperphyscia adglutinata* with spreading laminal soralia. **B**, *H. pandani* with laminal soralia. **C**, *H. pruinosa* with spreading marginal soralia. **D**, *H. isidiata* showing clumped isidia on a poorly developed thallus. **E**, Abundantly fertile *H. syncolla*. **F**, *H. pandani* showing the orange medulla exposed by an eruption of the soralia. Scales: 1 mm.