

# *Angiactis*, a new crustose lichen genus in the Roccellaceae, with species from Bermuda, the Galápagos Islands and Australia

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**ABSTRACT.** The new genus *Angiactis* Aptroot & Sparrius is described, with three species, *A. bermudensis* LaGreca sp. nov. from Bermuda, *A. littoralis* (Kantvilas) Aptroot & Sparrius comb. nov. from Australia and *A. spinicola* Aptroot & Sparrius sp. nov. from the Galápagos. The new genus differs from *Lecanographa* in the presence of a thalline exciple, and from *Llimonaea* in the non-corticate thallus and presence of a thalline exciple.

**KEYWORDS.** *Angiactis*, Arthoniales, *Lecanographa*, *Llimonaea*.



During the last decade, a number of old crustose Roccellaceae genera have been revised by various workers, revealing new characters. As part of this process, several larger genera in the family have been reduced in size, such as *Enterographa* (Sparrius 2004) and *Plectocarpon* (Ertz et al. 2006). During these studies, new circumscriptions of genera were made, and many new species have been described. For

example, Egea and Torrente (1994) split *Lecanactis* s.l. into several taxa, based on apothecium shape and pigments, and gave more attention to ascospore and ascus characters. As part of this work, related genera such as *Llimonaea* (Torrente & Egea 1991) were described.

More recently, Kantvilas (2004) described *Lecanographa littoralis*, a species quite different from

**Table 1.** Main differences between *Angiactis* and four related genera.

	<i>Angiactis</i>	<i>Dirina</i>	<i>Lecanographa</i>	<i>Llimonaea</i>	<i>Schismatomma</i>
Thalline exciple	present	present	absent	present	present
Thallus cortex	absent	present	absent	present	absent
Ascus type	<i>Grumulosa</i>	<i>Abietina</i>	<i>Grumulosa</i>	<i>Grumulosa</i>	<i>Abietina</i>
Ascospore color	hyaline	hyaline	hyaline	dark brown	hyaline
Ascospore wall	thick	thick	thin or thick	thick	thin
Excipulum color	carbonized	carbonized	carbonized	carbonized	hyaline
Excipular KOH reaction	none	none	green or none	green	green or none

*Llimonaea* and *Lecanographa*, but placed tentatively in the latter genus awaiting future examination. In the following two years, we collected two similar species in coastal habitats. While visiting the Galápagos Islands for two weeks in 2005, the first author noticed that the spiny *Scutia* bushes near the seashore at the Charles Darwin Research Station were covered with an unknown, crustose Roccellaceae. During fieldwork conducted by the first and last authors in the following year, this remarkable lichen was found on other hosts at additional localities in the Galápagos, but always close to the sea. It was initially thought to be a new species of the small genus *Llimonaea*, but it differs in several characters. During a collecting trip to the Bermudas the same year, the third author collected material from maritime rocks which appeared to belong to the same, undescribed genus. Here we formally describe this new genus as *Angiactis* in the Roccellaceae, with three species known, mainly differing in ascomatal shape, chemistry and substrate.

**MATERIAL AND METHODS**

Specimens for this study were collected in the field or borrowed from HO. TLC was carried out using solvent A (Orange et al. 2001). Measurements of ascospore sizes are based on at least 25 ascospores per specimen.

**Angiactis** Aptroot & Sparrius, *gen. nov.*

*Genus novum Roccellacearum, Lecanographae et Llimonaeae affine, sed ab ea differt essentialiter thallo crustaceo cretaceo non corticato, apotheciis rotundis vel elongatis, marginibus thallinibus, excipulo hypotecioque fusco vel niger, KOH non reagens, ascis cylindricis, Grumulosa-typis, paraphysibus gracilibus*

*anastomosantibus, ascosporibus leptoseptatibus clavatis 3–7-septatibus hyalinis gelatinosis.*

TYPE: *Angiactis littoralis* (Kantvilas) Aptroot & Sparrius.

**Description.** Thallus thick; cortex absent; medulla cretaceous; photobiont *Trentepohlia*. Ascomata irregularly rounded to elongate, with a thick thalline margin; disc black, often white pruinose; excipulum and hypothecium dark brown to black/carbonized, KOH-; hymenium not interspersed; paraphysoids slender, anastomosing, non-septate, not separating easily in water or KOH; asci of the *Grumulosa*-type, with KI+ blue inner wall and blue ring in the apical dome; ascospores hyaline, thin-walled, asymmetrical, clavate, 3–7-septate, surrounded by a thin perispore. Conidiomata known only from *A. bermudensis*, punctiform, immersed, black; conidia rod-shaped, non-septate, hyaline.

**Chemistry.** Thallus C+ and KC+ red (often in patches), KOH-, PD-, UV- or UV+ violet or whitish. Gyrophoric acid and/or erythrin; sometimes traces of lecanoric acid or methylgyrophorate detected with TLC.

**Etymology.** The name *Angiactis* is derived from the Greek “αγγειον” (receptacle) and “ακτος” (probably also meaning “shaped”, here used as in the name of the related genus *Lecanactis*) referring to the fruiting bodies covered by a thalline excipulum.

**Discussion.** Genera with elongate (lirelline) apothecia are scarce and most, like *Lecanographa* and *Opegrapha*, have ascospores with thick septa and lack a thalline margin around the apothecia. *Angiactis* is probably closely related to *Llimonaea*, which has a corticate thallus, ascospores that become brown and an excipulum that is KOH+ green. *Lecanographa*, in which the type species of *Angiactis* was first

**Table 2.** Main differences between the three known species of *Angiactis*.

	<i>A. bermudensis</i>	<i>A. littoralis</i>	<i>A. spinicola</i>
Ascomatal shape	rounded to stellate	rounded, unbranched	elongate, often forked
Ascomatal position	immersed	sessile, mostly constricted below	sessile, mostly adnate
Chemistry (major substances)	erythrin only	gyrophoric acid only	erythrin and gyrophoric acid
Ascospore length	17–28 $\mu\text{m}$	11–24 $\mu\text{m}$	17–25 $\mu\text{m}$
Ascospore septa	3–4(–6)	3–6(–7)	(3–)4–6
Ecology	saxicolous on limestone; coastal	saxicolous on limestone, and also on dead twigs; coastal	corticolous; coastal
Distribution	Bermuda	Australia	Galápagos

described—albeit with considerable hesitation and a lengthy discussion of the differentiating characters (see discussion in Kantvilas 2004)—has no thalline margin around the true exciple. An overview of the differences between *Angiactis*, *Dirina*, *Lecanographa*, *Llimonaea* and *Schismatomma* are given in **Table 1**. A fifth genus, *Sigridea* differs in having a corticate thallus containing psoromic acid in all species and the *Abietina*-type ascus.

We studied a Tasmanian specimen of the type species, growing on soft limestone rock, and found it to be close to the following new species from Bermuda and the Galápagos Islands. The main differences between all three species are listed in **Table 2**.

***Angiactis bermudensis*** LaGreca, *sp.*

*nov.*

**Figs. 1, 2A**

*Angiactis rupes calcares incolens, thallo cretaceo, apotheciis rotundis vel lirelliformis, ascosporibus vulgo triseptatibus vel tetriseptatibus 17–28  $\mu\text{m}$  longis 5–10  $\mu\text{m}$  latis, erythrinum continens.*

TYPE: BERMUDA. WARWICK PARISH: Stonehole Bay National Park, off South Road, on shaded, dry underhangs of limestone cliffs along the coast, 32°15'18"N, 64°48'48"W, 17 m alt., 16 Aug 2006, *LaGreca 1543* (BM, holotype).

**Description.** Thallus to 4 cm in diam., continuous, scurfy-crustose, chalk-white; cortex absent; medulla white, cretaceous, with crystals; photobiont *Trentepohlia*; prothallus indistinct. Ascomata ellipsoid to elongate, sometimes forked or stellate, solitary (not confluent), (0.2–)0.5(–1.0)  $\times$  (0.1–)0.3(–0.4) mm, immersed in thallus; disc pitch black, sometimes white pruinose; thalline margin thick, irregular, white; excipulum to 10  $\mu\text{m}$  wide,

often wider underneath the disc than on the edges, dark reddish brown to black in section, with crystals; hypothecium dark reddish brown, ca. 40  $\mu\text{m}$  tall, with crystals, often extending downwards into the thallus; hymenium pale reddish brown, ca. 50–60  $\mu\text{m}$  tall, sometimes eroding away in the center with age; paraphysoids ca. 1  $\mu\text{m}$  thick, highly branched and anastomosing, tips not swollen; epithecium ca. 10  $\mu\text{m}$  tall, red-brown, with brown crystals of ca. 2–3  $\mu\text{m}$  diam., KOH-; asci 40–50  $\times$  11–15  $\mu\text{m}$ , cylindrical, 8-spored, of the *Grumulosa*-type; ascospores hyaline, narrowly clavate to fusiform, thin-walled, (17–)25(–28)  $\times$  5–10  $\mu\text{m}$ , 3–4(–6)-septate, perispore present, ca. 1  $\mu\text{m}$  thick. Conidiomata black, punctiform, immersed, ca. 100–150  $\mu\text{m}$  in diameter, with a brown-orange pigment in section, KOH-; conidia rod-shaped, hyaline, ca. 4–6.5  $\times$  1.5(–2.5)  $\mu\text{m}$ .

**Chemistry.** Thallus C+ red (at least around apothecia or apothecium margins), KOH-, PD-, UV+ violet. Erythrin plus traces of two unidentified compounds were found with TLC. These unidentified compounds were visible in solvent A only. No gyrophoric or lecanoric acid was detected.

**Etymology.** Named after the island group where the type was collected.

**Distribution and ecology.** Endemic to the Bermuda Islands. Saxicolous on limestone rock on shaded, dry underhangs on or near the coast.

**Additional specimens examined.** BERMUDA. ST. GEORGE'S PARISH: Town of St. George, The Unfinished Church on Folly Road, on brick/mortar on inside wall of church, 10 Aug 2006, *LaGreca 1544* (BM); St. David's Island, Great Head Park, on steep maritime cliff adjacent to "The Crack," 19 Aug 2006, *LaGreca 1545* & *J. McCabe* (ABL, BM, HO).

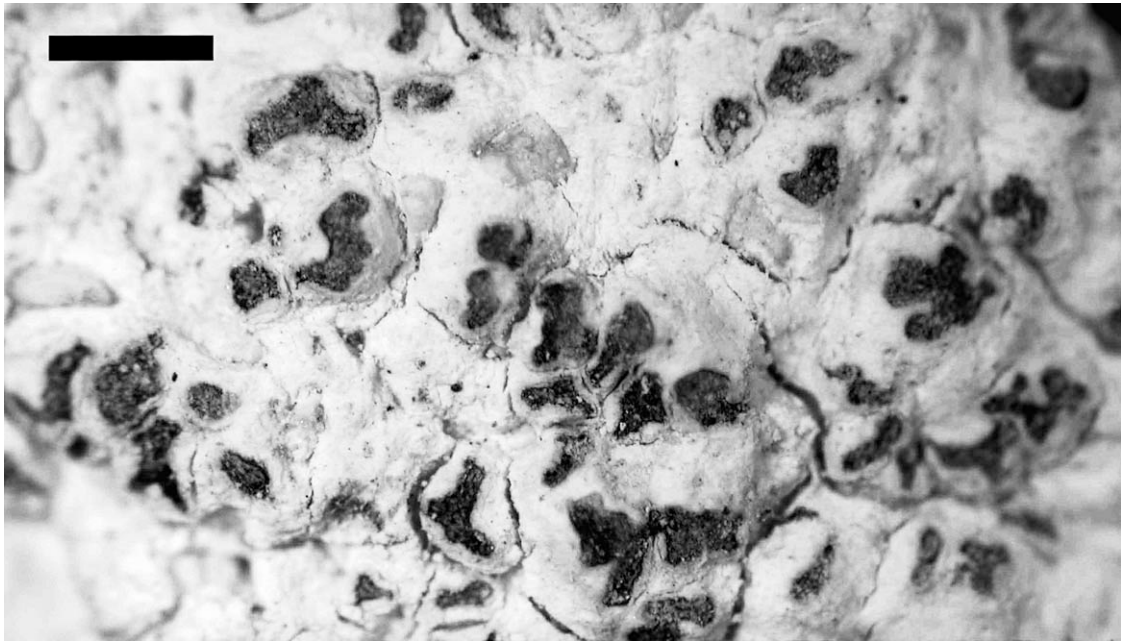


Figure 1. *Angiactis bermudensis*, LaGreca 1544 (BM). Habit of the thallus with ascomata. Scale: each increment = 1 mm.

***Angiactis littoralis*** (Kantvilas) Aptroot & Sparrius, *comb. nov.* Figs. 2B, 3  
*Lecanographa littoralis* Kantvilas, Symb. Bot. Upsal. 34(1): 197. 2004.

TYPE: AUSTRALIA. WESTERN AUSTRALIA: Cape Leeuwin, on dead *Melaleuca* twigs in coastal heathland, 34°22'S, 115°07'E, 9 Oct 1992, *Kantvilas & Jarman 320/92* (HO, holotype; BM, GZU, PERTH, UPS, isotypes).

**Description.** Thallus white to pale yellowish cream, continuous, scurfy-crustose to byssoid; cortex absent; medulla white, cretaceous, to 1 mm thick,

containing crystals; photobiont *Trentepohlia*; prothallus indistinct. Ascomata numerous, adnate to basically constricted, rounded, unbranched, to ca. 0.3–1 mm diam.; disc black, coarsely white pruinose; thalline margin prominent, 0.06–0.1 mm wide of the same color and structure as the thallus, ecorticate; excipulum dark brown, KOH-, to 10 µm wide; epithecium olive-brown, 12–20 µm thick, KOH-; hypothecium brown to black, often extending downwards, upper layer (subhymenium) hyaline to orange-brown, 25–80 µm tall, KOH-; hymenium 60–75(–100) µm tall, hyaline, K/I+ pale blue;

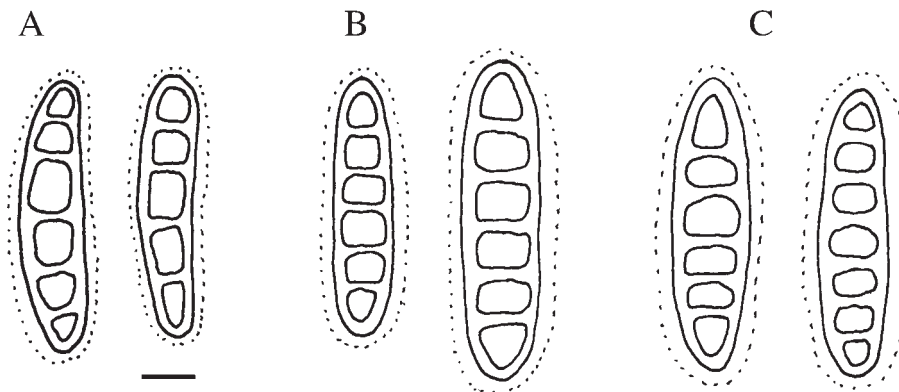


Figure 2 A–C. *Angiactis* ascospores. A. *A. bermudensis*, LaGreca 1544 (BM). B. *A. littoralis*, Kantvilas 311/97 (HO). C. *A. spinicola*, Aptroot 63413 (CDS, holotype). Scale: bar = 5 µm.



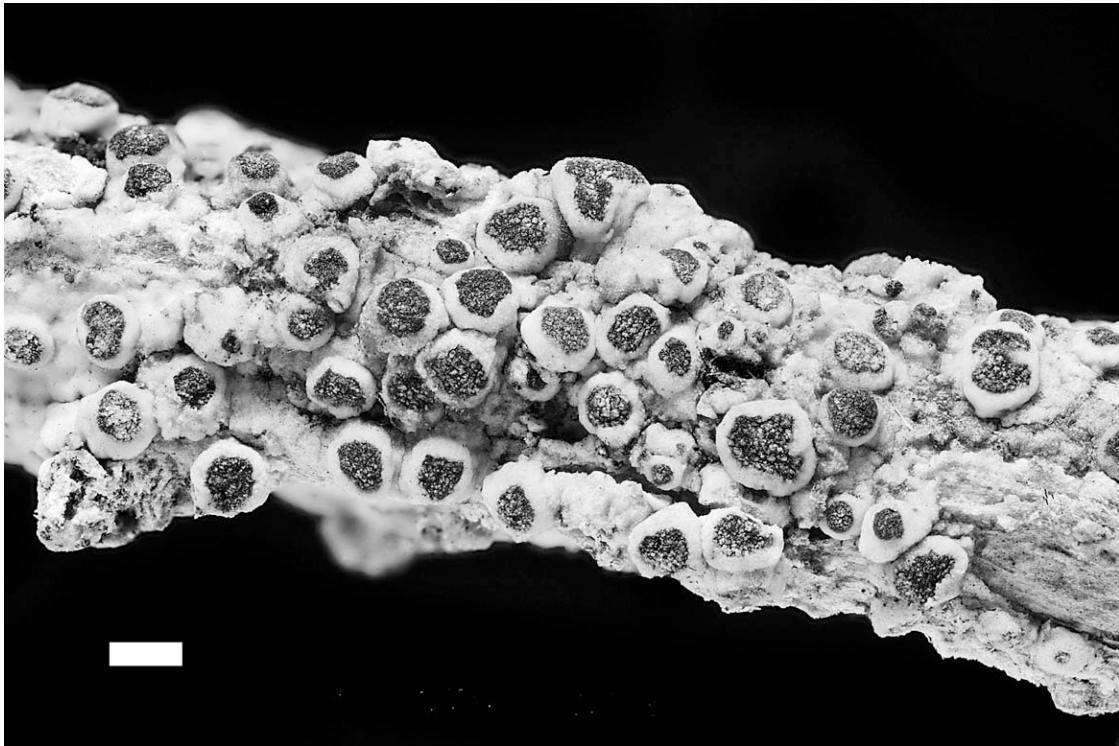


Figure 3. *Angiactis littoralis*, Kantvilas & Jarman 320/92 (BM, isotype). Habit of the thallus with ascomata. Scale: bar = 5 mm.

paraphysoids slender, ca. 1  $\mu\text{m}$  wide, anastomosing; asci cylindrical, 65–90  $\times$  10–16  $\mu\text{m}$ , approximating the *Grumulosa*-type and lacking any discernible amyloid sheath between the inner ascus wall and the ascoplasm visible in younger asci; ascospores 3–6(–7)-septate, hyaline, narrowly ellipsoid to fusiform, slightly curved, 11–24  $\times$  4–8  $\mu\text{m}$ , surrounded by a 0.5–1  $\mu\text{m}$  thick perispore. Conidiomata not observed.

**Chemistry.** Thallus C+ reddish, KOH-, PD-, UV-. Gyrophoric acid and lecanoric acid (trace) detected with TLC.

**Distribution and ecology.** Endemic to Australia (Tasmania and Western Australia).

**Note.** Many of the characters above are derived from Kantvilas (2004). The drawing of the ascomata in Kantvilas (2004) shows structures that can be interpreted as interhymenial strands, but these are in fact folded margins of the apothecia and have no taxonomic value. The same structures can also sometimes be found in *Angiactis bermudensis*.

**Additional specimen examined.** AUSTRALIA. TASMANIA: Flinders Island, Cave Beach, on soft tertiary limestone, 1997, *Kantvilas* 311/97 (HO).

**Angiactis spinicola** Aptroot & Sparrius, *sp. nov.*

**Figs. 2C, 4**

*Angiactis epiphyticus*, thallo cretaceo, apotheciis lirelliformibus, ascosporibus vulgo tetrasetatibus 17–25  $\mu\text{m}$  longis 3–6  $\mu\text{m}$  latis, acidum gyrophoricum methylgyrophoratum erythrinumque continens.

**TYPE:** ECUADOR. GALÁPAGOS ISLANDS: Santa Cruz Island, coastal cliffs E of Puerto Ayora near Charles Darwin Research Station, on spines of *Scutia spicata*, 0°44'45"S, 90°17'39"W, 20 m alt., 29 May 2005, *Aptroot* 63413 (CDS 30168, holotype; ABL, BM, isotypes).

**Description.** Thallus white to a bit ochraceous, continuous, to 5 cm diam.; cortex absent; medulla white, cretaceous, to 1 mm thick, with crystals; photobiont *Trentepohlia*; prothallus indistinct. Ascomata numerous, sessile, rounded to usually elongate, often forked, ca. 0.1–0.5  $\times$  0.3–1.0 mm; disc black, sometimes white pruinose; thalline margin ca. 0.2 mm wide of the same color and structure as the thallus; excipulum dark brown, KOH-, to 10  $\mu\text{m}$  wide; epithecium red-brown, KOH-; hypothecium dark brown to black, often extending downwards, upper layer (subhymenium)

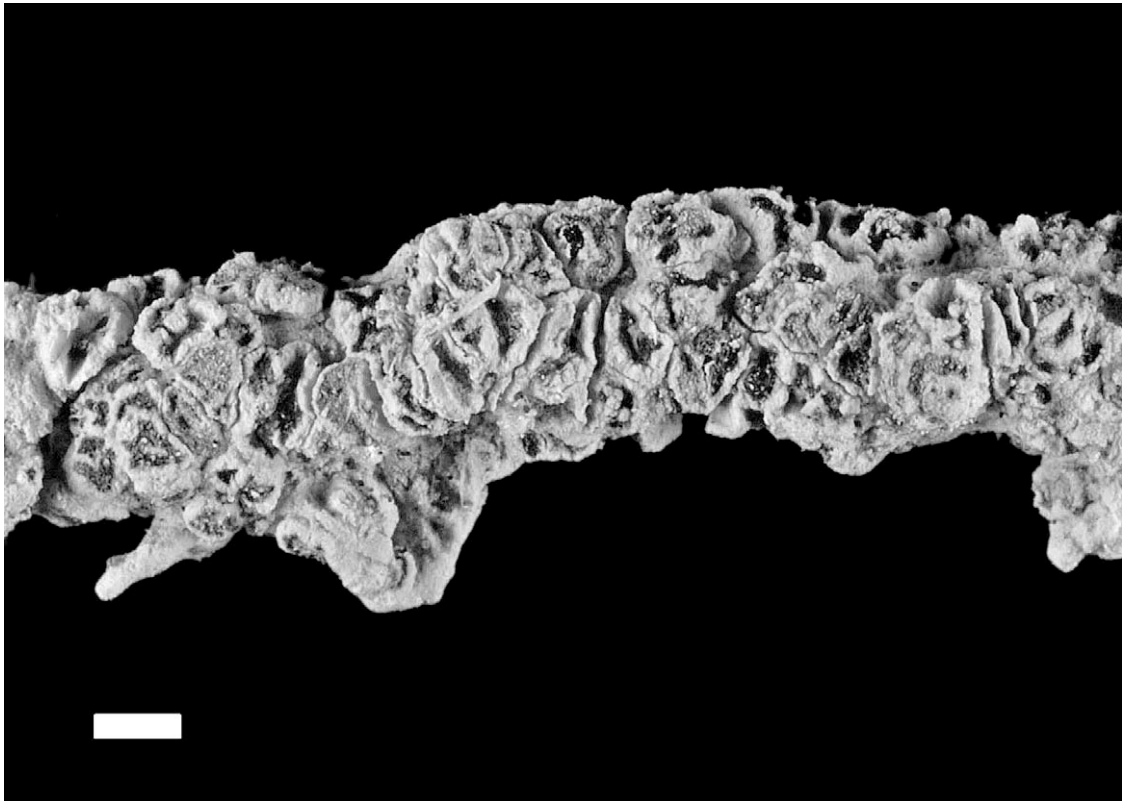


Figure 4. *Angiactis spinicola*, Aptroot 63413 (CDS, holotype). Habit of the thallus with ascomata. Scale: bar = 1 mm.

hyaline to orange-brown, 40–100  $\mu\text{m}$  tall; hymenium ca. 50  $\mu\text{m}$  tall, hyaline; paraphysoids ca. 1  $\mu\text{m}$  wide, anastomosing; asci clavate-cylindrical, *Grumolosa*-type, 8-spored, 70–90  $\times$  15–20  $\mu\text{m}$ ; ascospores (3–)4–6-septate, hyaline, clavate, straight, 17–25  $\times$  (3–)5–6  $\mu\text{m}$ , surrounded by a 1–2  $\mu\text{m}$  thick perispore. Conidiomata not observed.

**Chemistry.** Thallus C+ red (at least around apothecia or apothecium margins), KOH-, PD-, UV+ whitish. Erythrin, gyrophoric acid and methyl gyrophorate detected with TLC.

**Etymology.** Named after the preference of this species for spines and twigs.

**Distribution and ecology.** Endemic to the Galápagos. This species is common and abundant on spines of *Scutia spicata*, twigs of mangroves and twigs of *Cryptocarpus pyriformis* on the coastal cliffs close to the Charles Darwin Research Station, Santa Cruz. It was not encountered during trips to other islands of the Galápagos.

**Selected additional specimens.** ECUADOR.

GALÁPAGOS ISLANDS: Santa Cruz Island, Puerto Ayora, near the Charles Darwin Research Station, 00°44'32"S, 90°18'10"W, ca. 1 m alt., on bark of *Rhizophora* twigs in mangrove swamp, 24 May 2005, Aptroot 63065 (CDS 29793); along the S coast of Santa Cruz close to the Charles Darwin Research Station, 00°44'39"S, 90°18'02"W, ca. 1 m alt., among bare coastal lava rocks with *Cryptocarpus pyriformis*, occasionally in between on bark of *Cryptocarpus pyriformis* twigs, 10 Feb 2006, Bungartz 3424 (CDS 27130).

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