

Three new marine ascomycetes from driftwood in Australian sand dunes

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Caryospora australiensis sp. nov., *Platystomum scabridisporum* sp. nov. and *Savoryella melanospora* sp. nov. are described from driftwood collected from a sand dune at Rye, on the Mornington Peninsula Nature Park, Victoria, Australia. These species are compared with other taxa in these and related genera.

Key Words—arenicolous; marine fungi; taxonomy.

Early studies on the marine fungi of Australia were carried out by Cribb and Cribb (1955, 1956, 1960, 1969). More recently Hyde (1991, 1992, 1993a, b) and Kohlmeyer and Volkmann-Kohlmeyer (1991a) have documented the occurrence of marine fungi from the tropical waters of Queensland to the subtropical shores in the Melbourne area. Hyde (1996) reviewed our knowledge of marine fungi from Australia, listing 100 species, extensively illustrating the fungi found and with suggestions for future research. The Mornington Peninsula Nature Park has a well-developed sand dune system with a significant amount of driftwood buried in the sand. Wood was collected from such a habitat and examined for the presence of marine fungi.

Material and Methods

Wood buried in sand was collected in the Mornington Peninsula Nature Park, Rye, Victoria, Australia. Material collected was returned to the laboratory in Hong Kong where it was incubated in sterile, humid chambers at room temperature. Examination of material follows the well-adopted procedures described by Jones and Hyde (1988).

Taxonomy

Caryospora australiensis Abdel-Wahab & E. B. G. Jones, sp. nov. Figs. 1–9

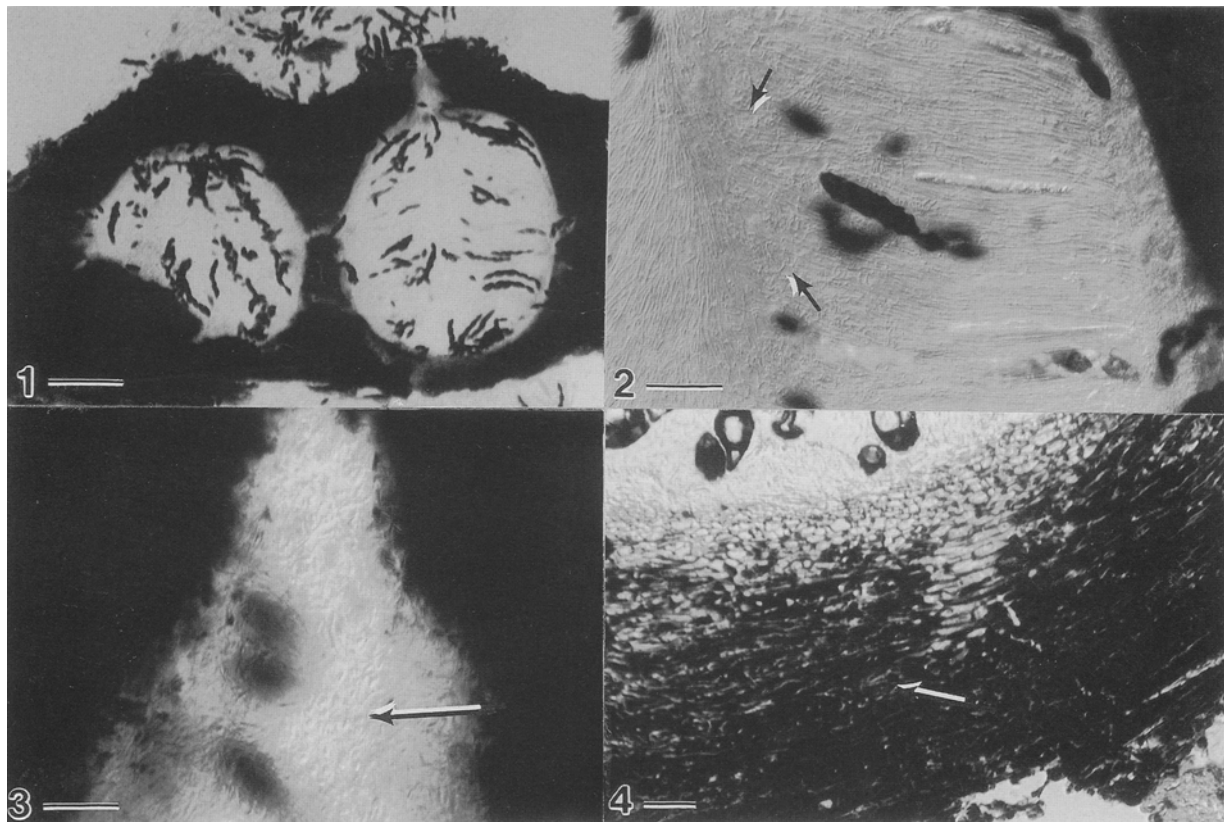
Etym.: *australiensis* in reference to the place where the fungus was first collected.

Ascomata 870–1000 μm alta, 830–850 μm diam, late, conica vel subglobosa, basaliter complanata vel rotundata, immersa vel erumpentia, carbonacea, papillata, centro ostiolata, solitaria vel gregaria. Peridium bistratum; stratum exterius ad apicem 110–190 μm cras-

sum et basi 72–177 μm crassum, brunneum vel nigrum. Trabeculae ad apicem 1.2–2 μm diam, supra ascos anastomosantes, periphysibus transientes, in matrice gelatinosa inclusae. Asci 162–215 \times 20–30 μm , cylindrici vel subcylindrici, fissitunicati, pedunculati, octospori. Ascospores 30–44 \times 12–17 μm , uni-vel biseriatae, tri-septatae, nigrae, constrictae vel non constrictae, ellipsoideae, striatae.

Holotypus: In ligno indet., Mornington Peninsula, Rye, Victoria, Australia, Aug. 1998, coll. E. B. G. Jones, IMI 379748.

Ascomata 870–1000 μm high, 830–850 μm in diam, broadly conical or subglobose, with a flat or rounded base, immersed to erumpent, carbonaceous, papillate, with a central ostiole, solitary or gregarious (Fig. 1). Papillae 85–200 μm long, 100–155 μm in diam, ostiolar canal 60–180 μm long and 50–100 μm in diam, periphysate; periphyses 1.5 μm in diam (Figs. 1, 3). Peridium two-layered: outer layer carbonaceous, in the superficial part of the ascoma 110–190 μm thick, composed of heavily melanized angular pseudoparenchymatous cells; in the immersed part of the ascoma 72–177 μm thick, composed of brown to dark brown angular or horizontally oriented palisade-like cells; host cells occasionally incorporated in large amount inside the peridial wall; cells in the basal area acute angle of the cone palisade-like, vertically oriented, brown to dark brown in colour; inner layer 12–20 μm thick throughout the ascomatal cavity and composed of polygonal hyaline cells (Fig. 4). Trabeculae 1.2–2 μm in diam at the tip, anastomosing above the asci, merging with the periphyses in the ostiolar canal, and embedded in a gelatinous matrix (Figs. 2, 6). Asci 162–215 \times 20–30 μm (\bar{X} = 181.8 \times 23.7 μm , n=30), peripheral, cylindrical to subcylindrical, fissitunicate, pedunculate, eight-spored, and with a wide ocular chamber (Figs. 5, 6). Ascospores 30–44 \times 12–17 μm



Figs. 1–4. *Caryospora australiensis*, differential interference light micrographs.

1. Longitudinal section through aggregated asci, each one with a papilla and ostiole. 2. Magnified part of a longitudinal section through an ascus showing trabeculae anastomosing above the asci (arrowed) and embedded in a gelatinous matrix. 3. Longitudinal section through the ostiolar canal, showing the periphyses (arrowed) filling the ostiolar canal cavity. 4. Section through the peridium with melanzed black outer stratum (arrowed) and inner stratum consisting of polygonal hyaline cells. Bar lines: Fig. 1 = 240 μm ; Fig. 2 = 60 μm ; Figs. 3, 4 = 20 μm .

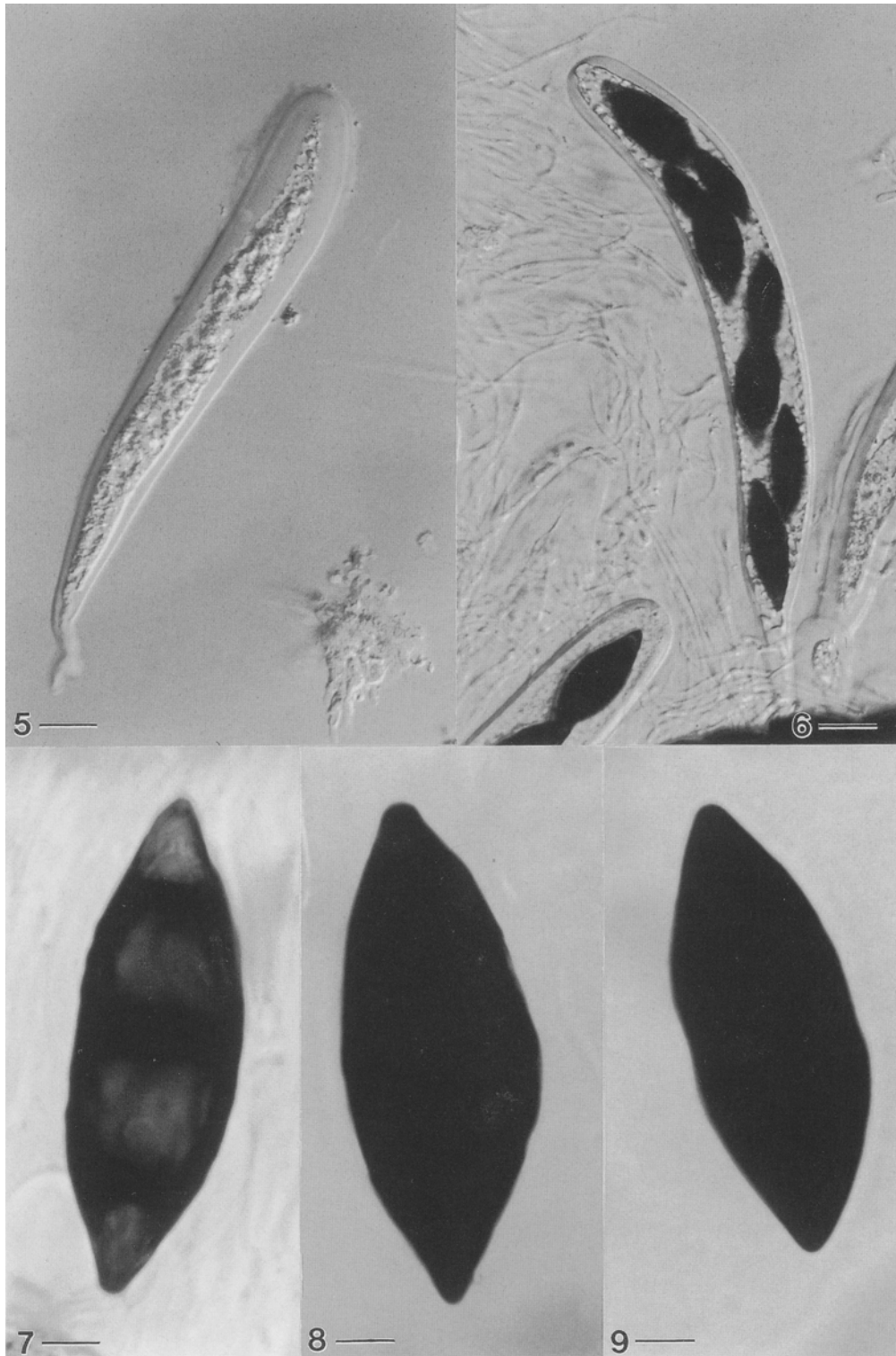
(\bar{X} = 38.2 \times 14.9 μm , n = 50), uni- or biseriate, 3-thickened eu-septate, the end cells faint in colour, all the cells becoming black when mature, constricted or not at the central septum, ellipsoid, and smooth-walled, the median

cells becoming striate with age (Figs. 7–9).

Type material: IMI 379748 Aug. 1998, on driftwood buried in sand, at the base of sand dune, at Mornington Peninsula, Rye, Victoria, Australia. coll. E. B. G. Jones

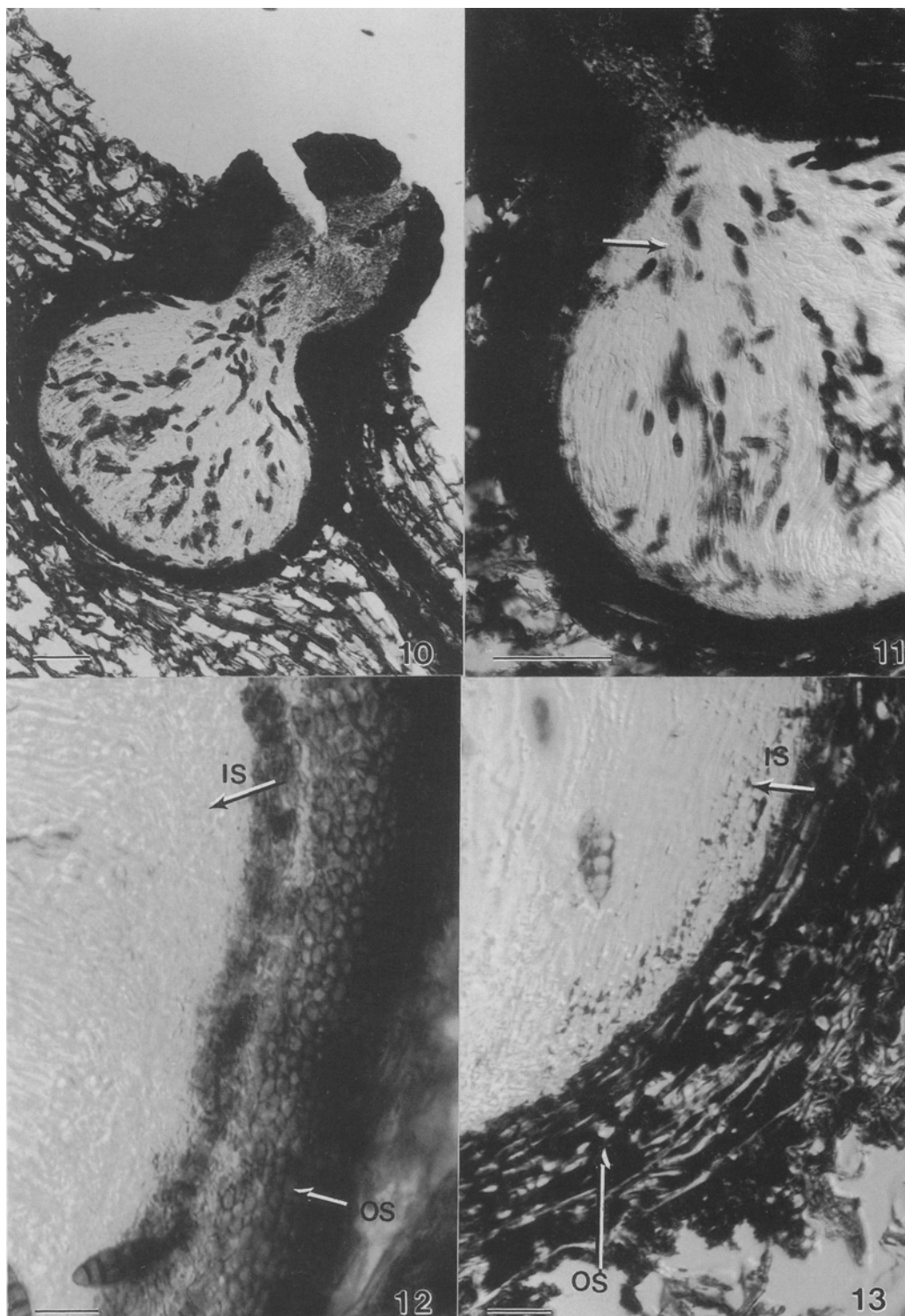
Table 1. Morphological comparison of *Caryospora australiensis*, *C. langloisii* and *C. striata*.

	<i>C. australiensis</i>	<i>C. langloisii</i> (Barr, 1979)	<i>C. striata</i> (Barr, 1979)
Ascomata	870–1000 μm high, 830–850 μm in diam, black	1 mm in diam, dark brown	660 μm in diam, dark brown
Peridium	72–177 μm thick at the base, 112–192 μm thick at the sides and the upper half of the ascomata	ca. 50 μm wide at base, up to 78 μm wide at sides	ca. 30 μm wide, thickened toward exposed apex
Asci	162–215 \times 20–30 μm , cylindrical to subcylindrical, with wide ocular chamber	110–170 \times 40–45 μm , broadly oblong	240 \times 18–22 μm
Ascospores	30–44 \times 12–17 μm (\bar{X} = 38.2 \times 14.9 μm), 3-septate becoming opaque in age, constricted or not at the central septum, ellipsoid, smooth-walled becoming striate at maturity, especially the mid-cells	32–50 \times 15–20 μm (\bar{X} = 41 \times 17.5 μm), rich reddish brown, ellipsoid fuscoid, primary septum median, slightly constricted, secondary septa near each tip, not constricted, with one large globule in each cell, surrounded by narrow gelatinous sheath, smooth, some showing wrinkling of surface especially at the apex	40–50 \times 14–15 μm (\bar{X} = 45 \times 14.5 μm), dark reddish brown, ellipsoid, primary septum median, constricted, no additional septa seen, contents with one large and one small globule in each cell, wall finely roughened



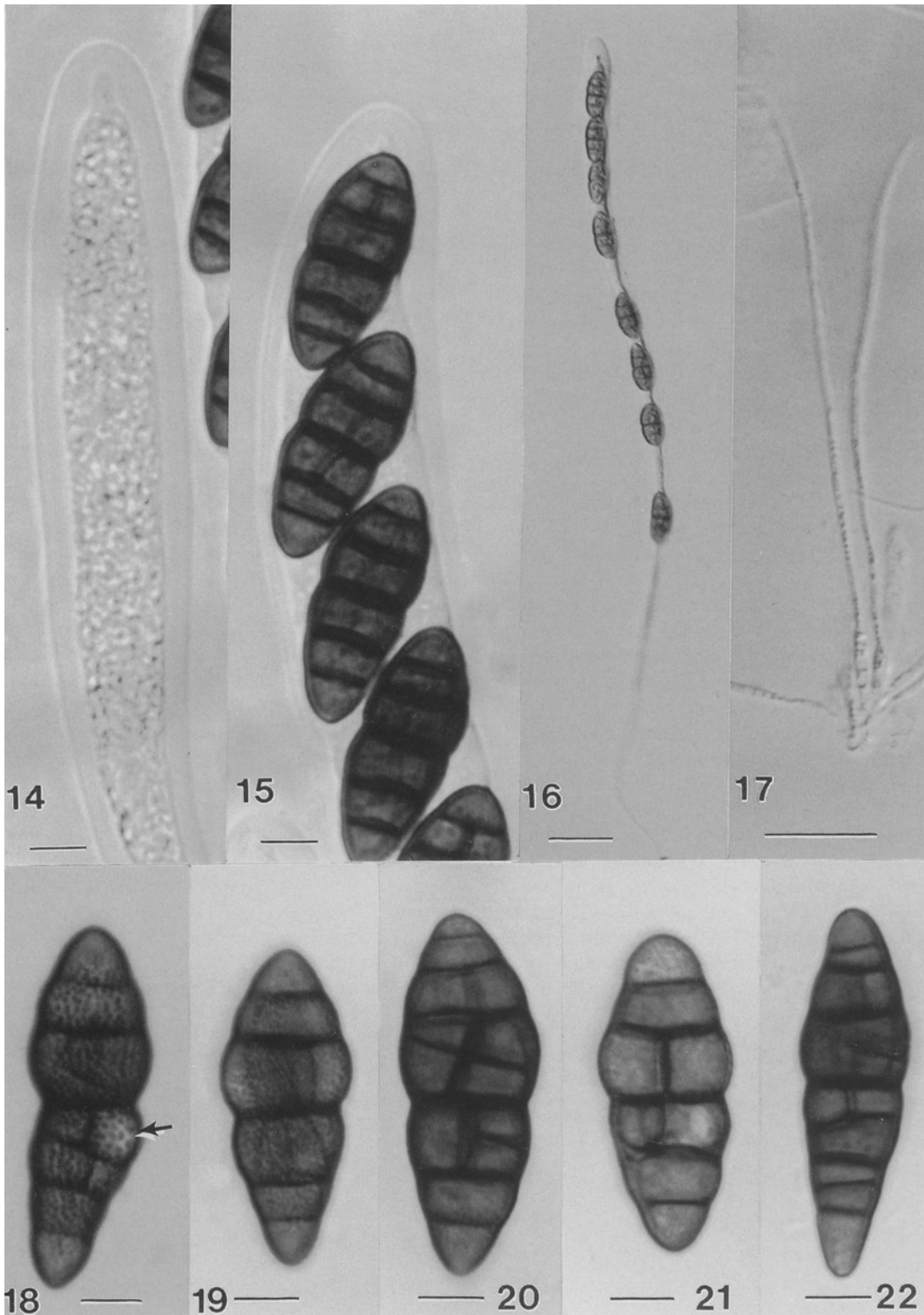
Figs. 5–9. *Caryospora australiensis*, differential interference light micrographs.

5, 6. Immature (Fig. 5) and mature (Fig. 6) asci, note the ocular chamber in the mature ascus. 7–9. Ascospore 3-septate, fuscous, and intensively black at maturity. Bar lines: Figs. 5, 6 = 15 μm ; Figs. 7–9 = 5 μm .



Figs. 10–13. *Platystomum scabridisporum*, differential interference light micrographs.

10. Longitudinal section through a mature ascoma embedded in a woody substratum. 11. Magnified part of centrum with pseudoparaphyses, branched and anastomosing above the asci (arrowed), merging with the paraphyses in the ostiolar canal. 12, 13. Section through the peridial wall with an outer stratum (arrowed OS) of thick walled melanized cells, interspersed with cells of the host; and the inner stratum (arrowed IS) of hyaline rounded cells. Bar lines: Figs. 10, 11 = 100 μm ; Figs. 12, 13 = 15 μm .



Figs. 14–22. *Platystomum scabridisporum*, differential interference light micrographs. 14, 15. Immature (Fig. 14) and mature (Fig. 15) asci, note apical ocular chamber. 16. Fissitunicate dehiscence of the ascus. 17. Hyaline trabeculae. 18–22. Morphological variation of ascospores with verrucose spore wall (arrowed Fig. 18). Bar lines: Figs. 14, 15, 17=3 μm ; Fig. 16=25 μm ; Figs. 18–22=5 μm .

(Holotype).

Habitat: Saprobic on driftwood.

Distribution: Australia.

Of the six described *Caryospora* De Not. species, *C. australiensis* most closely resembles *C. langloisii* Ellis & Everh. and *C. striata* (Niessl) Scheinpflug. *Caryospora australiensis* differs from *C. langloisii* in having cylindrical, longer and narrower asci and smaller ascospores without a gelatinous sheath. *Caryospora australiensis* differs from *C. striata* in having larger ascomata and smaller ascospores, while it differs from both species in having 3-thickened eu-septate ascospores becoming black at maturity (Table 1) (Barr, 1990). Hyde (1989) described *Caryospora mangrovei* K. D. Hyde from mangrove wood collected in Brunei with 1-3-septate hazel brown ascospores measuring $36-60 \times 16-24 \mu\text{m}$, but Kohlmeyer and Volkmann-Kohlmeyer (1991b) transferred this species to *Coronopapilla mangrovei* (K. D. Hyde) Kohlm. & Volkm.-Kohlm.

Platystomum scabridisporum Abdel-Wahab & E. B. G. Jones, sp. nov. Figs. 10-22

Etym.: From the Latin *scabridus* meaning "with delicate projections" in reference to the verrucose ascospore cell wall and *-sporum* meaning "-spored".

Ascomata $465-740 \mu\text{m}$ alta, $400-650 \mu\text{m}$ lata, subglobosa, immersa, erumpentia, ostiolata, nigra, coriacea, solitaria vel gregaria. Peridium bistratum; stratum exterius $20-42 \mu\text{m}$ crassum, nigrum, textura angulari formatum, cellulis hospitis includens; stratum intimium $15-32 \mu\text{m}$ crassis, ex cellulis parvis hyalinis pseudoparaphysibus transientibus compositum; ostiolum depressum in centro sulci apicale, circulare; canalis ostioli $220-350 \mu\text{m}$ longus et $60-100 \mu\text{m}$ diam, cylindricus, reticulo periphysium ramosarum septatarum usque $60 \mu\text{m}$ longarum et $1-2 \mu\text{m}$ diam impletus. Trabeculae $1.2-2 \mu\text{m}$ diam, ad basim eramosae, supra ascos ramosae et anastomosantes, periphysibus transientibus in matrice gelatinosa inclusae. Asci $105-170 \times 12-15 \mu\text{m}$, cylindrici, pedunculati, octospori, fissitunicati. Ascospores $20-32 \times 7-11 \mu\text{m}$, fusiformes, muriformes, $5-7(-8)$ trans-

septatae, $1-2(-3)$ longiseptatae, brunneae, scabridae.

Holotypus: In ligno indet., Mornington Peninsula, Rye, Victoria, Australia, Aug. 1998, coll. E. B. G. Jones, IMI 379750.

Ascomata $465-740 \mu\text{m}$ high, $400-650 \mu\text{m}$ in diam ($\bar{X} = 569.5 \times 464 \mu\text{m}$, $n = 10$), subglobose, immersed, papillate, erumpent, ostiolate, black, coriaceous, and solitary or gregarious (Fig. 10); Papillae beaked, $120-235 \mu\text{m}$ wide, $220-350 \mu\text{m}$ long. Peridium two-layered (Figs. 12, 13): outer layer $20-42 \mu\text{m}$ thick at the base and the sides, $60-135 \mu\text{m}$ thick near the ostiole, composed of melanized cells forming textura angularis, interspersed with cells of the host; and the innermost layer $15-32 \mu\text{m}$ thick at the base, $5-10 \mu\text{m}$ thick at the sides which is absent in the upper part of ascomatal cavity and ostiolar canal, composed of hyaline rounded or weakly angular small cells that merge with the pseudoparaphyses. Ostiole depressed in the center of the apical furrow, slit-like with an ostiolar canal $220-350 \mu\text{m}$ long, $60-100 \mu\text{m}$ wide, cylindrical, filled with a network of branched, septate periphyses up to $60 \mu\text{m}$ long, $1-2 \mu\text{m}$ in diam at their tips (Figs. 10, 11). Trabeculae $1.2-2 \mu\text{m}$ in diam, unbranched at the base, becoming branched and anastomosing above the asci, merging with the periphyses in the ostiolar canal, and embedded in a gelatinous matrix (Figs. 11, 17). Asci $105-170 \times 12-15 \mu\text{m}$ ($\bar{X} = 136.2 \times 13 \mu\text{m}$, $n = 30$), cylindrical, pedunculate, eight-spored, fissitunicate, with an apical ocular chamber (Figs. 14-16). Ascospores $20-32 \times 7-11 \mu\text{m}$ ($\bar{X} = 25.3 \times 8.7 \mu\text{m}$, $n = 50$), fusiform, uni- or biseriolate, muriform, with $5-7(-8)$ transverse septa and $1-2(-3)$ longitudinal septa, constricted at the central septum, brown with a rough or verrucose spore wall surface (Figs. 18-22).

Type material: IMI 379750, Aug. 1998, on driftwood buried in sand, at the base of a sand dune, at Mornington Peninsula, Rye, Victoria, Australia, coll. E. B. G. Jones (Holotype).

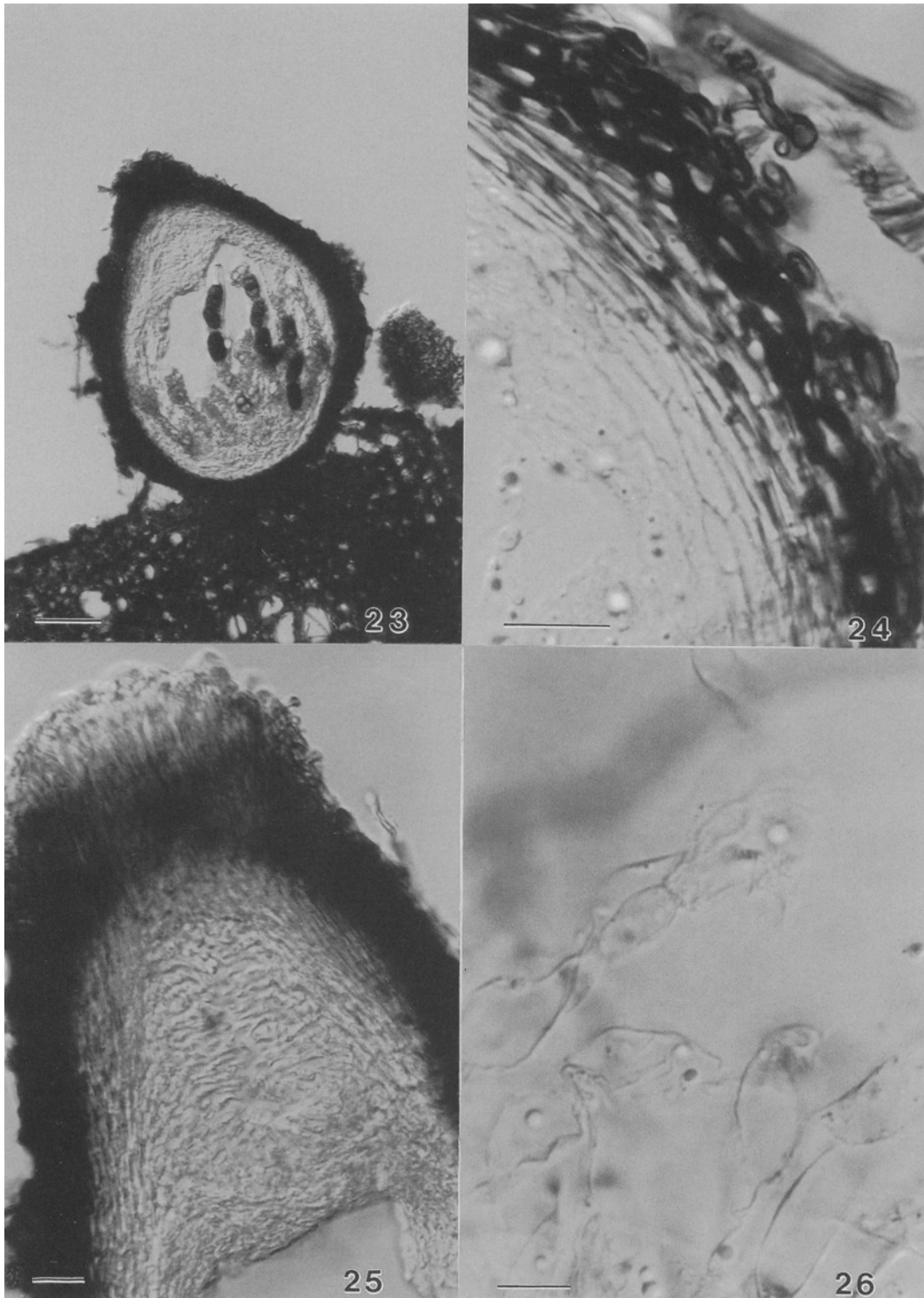
Habitat: Saprobic on driftwood.

Distribution: Australia.

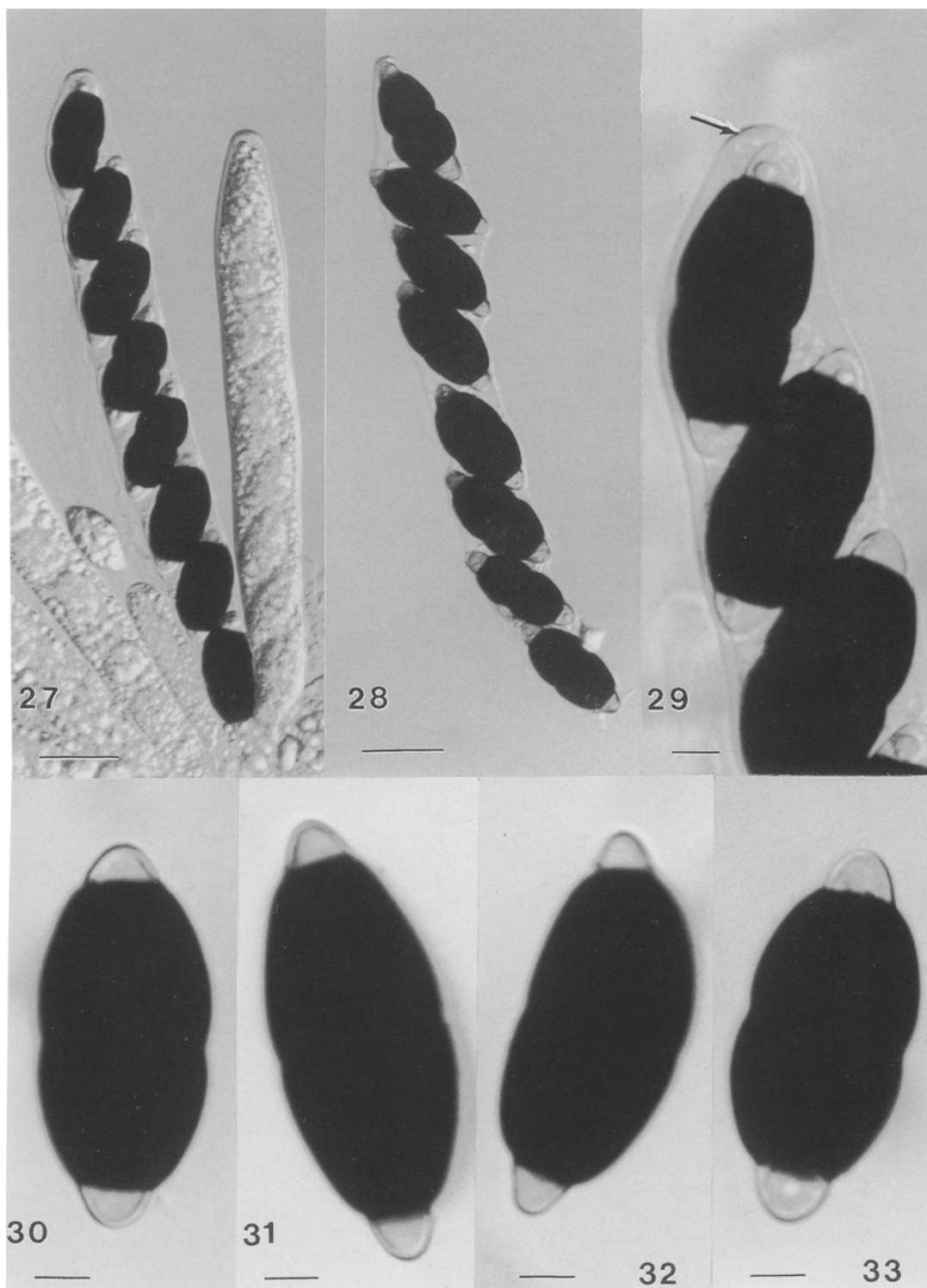
Our collection is assigned to the genus *Platystomum*

Table 2. Morphological comparison of *Platystomum scabridisporum*, *P. compressum* and *P. obtectum*.

	<i>P. scabridisporum</i>	<i>P. compressum</i> (Barr, 1990)	<i>P. obtectum</i> (Barr, 1990)
Ascomata	$465-740 \mu\text{m}$ high, $400-650 \mu\text{m}$ in diam, black	$440-725 \mu\text{m}$ in diam	$440-770(-1000) \mu\text{m}$ in diam
Papilla	Peaked, $120-235 \mu\text{m}$ wide, $220-350 \mu\text{m}$ long	$220 \mu\text{m}$ wide and high, compressed, surrounded by brown hyphae	Compressed or occasionally rounded or triangular, $110-165 \mu\text{m}$ wide and high
Peridium	$35-74 \mu\text{m}$, up to $135 \mu\text{m}$ wide	$30-50 \mu\text{m}$ wide	$25-50 \mu\text{m}$, up to $90 \mu\text{m}$ wide
Asci	Cylindrical, $105-170 \times 12-15 \mu\text{m}$, 8-spored	Cylindrical, $100-160 \times 10-15 \mu\text{m}$, 8-spored	Clavate, $(80-100-140) \times 12-20 \mu\text{m}$, 4-8-spored
Ascospores	$20-32 \times 7-11 \mu\text{m}$ ($\bar{X} = 25.3 \times 8.7 \mu\text{m}$), brown, $5-7(-8)$ transverse septa, $1-2(-3)$ longitudinal septa, rough spore wall surface, without gelatinous sheath	$(15-18-28 \times 6-8(-9) \mu\text{m}$ ($\bar{X} = 23 \times 7 \mu\text{m}$), reddish brown, $(3-4-5)-(6-7-8)$ septa, one longitudinal septum in the mid cells, wall smooth, surrounded by a gelatinous sheath	$(18-20-32 \times (6-7-10-11) \mu\text{m}$ ($\bar{X} = 26 \times 9.3 \mu\text{m}$), clear brown to reddish brown, $(3-5(-7)$ septa, one longitudinal septum in one or a few mid cells, wall smooth or verruculose, surrounded by gelatinous sheath



Figs. 23–26. *Savoryella melanospora*, differential interference light micrographs. 23. Longitudinal section through an ascoma. 24. Peridial wall with an outer stratum of melanized thick-walled, dark brown to black cells; and an inner stratum of hyaline to yellow brown, elongated cells. 25. Longitudinal section through the neck with paraphyses. 26. Paraphyses. Bar lines: Fig. 1 = 50 μm ; Figs. 2–4 = 15 μm .



Figs. 27–33. *Savoryella melanospora*, differential interference light micrographs.
27–29. Immature and mature asci with apical thickening (arrowed in Fig. 29). 30–33. Dark brown to fuscous ascospores (central cells) with hyaline to sub-hyaline end cells. Bar lines: Figs. 27, 28 = 20 μm ; Figs. 29–33 = 5 μm .

Trev., Platystomaceae, Melanomatales (Barr, 1990) in the *P. compressum* (Pers.: Fr.) Trev. group. The Platystomaceae is based on the genus *Platystomum* Trev. The type species of this genus, *P. compressum*, however has usually been treated as a *Lophiostoma* species (Holm and Holm, 1988). Eriksson and Hawksworth (1991) suggested that *Platystomum* is kept as a synonym of *Lophiostoma*, and in accordance with Holm and Holm (1988) the Platystomaceae is treated as a synonym of Lophiostomataceae. However, we assign our species to *Platystomum* as the ascomata are immersed, becoming erumpent with apex well developed, papillate, pore slit-like, asci cylindrical and narrow, trabeculae in a gel matrix and with brown, muriform ascospores. The fungus resembles the marine bitunicate genus *Aigialus* Kohlm. & S. Schatz but differs in the smaller, narrower asci without the well-developed ascus apparatus and fewer septate ascospores which are not flattened and lack a gelatinous cap (Kohlmeyer and Schatz, 1985).

The genus *Platystomum* comprises 6 species (Chester and Bell, 1970; Barr, 1990). Our species most closely resembles *P. compressum* and *P. obtectum* Peck but differs in the smaller ascomata, longer neck, wider peridium, longer asci and in the greater number of transverse and longitudinal septa to the ascospores (Table 2). In *P. compressum* and *P. obtectum* the ascospores are surrounded by a mucilaginous sheath which is absent in *P. scabridisporum*. The verrucose wall of *P. scabridisporum* is clearly visible in Figs. 18 and 19.

Savoryella melanospora Abdel-Wahab & E. B. G. Jones, sp. nov. Figs. 23–33

Etym.: From the Greek *melan* meaning “black” in reference to the intensively black ascospores and -spora meaning “-spored”.

Ascomata 160–305 μm alta, 184–225 μm lata, globosa vel subglobosa, obliqua vel horizontalia, solitaria vel gregaria, semi-immersa vel superficialia, ostiolata, papillata. Colla 80–275 \times 70–160 μm , lateralia, periphysata. Peridium bistratum, textura angulari formans. Asci 170–212 \times 15–25 μm , octospori, cylindrici, pedunculati, unitunicati, persistentes, ad apicem truncati et annulo crasso in amyloideo praediti. Ascospores 32–45 \times 15–18 μm , ellipsoideae, uniseriatae, triseptatae, cellulis centralibus nigris, cellulis polaribus subhyalinae.

Holotypus: In ligno indet., Mornington Peninsula,

Rye, Victoria, Australia, Aug. 1998, coll. E. B. G. Jones, IMI 379749.

Ascomata 160–305 μm high, 184–225 μm in diam, globose to subglobose, oblique to horizontal, solitary or gregarious, partly immersed to superficial, ostiolate, papillate, membranous and dark brown to black (Fig. 23). Neck 80–275 μm long, 70–160 μm in diam, lateral, brown, lighter and slightly tapering towards the apex (Fig. 25). Ostiolar canal 50–80 μm in diam, and periphysate; periphyses 20–25 μm long, 0.5 μm in diam (Fig. 25). Peridium two-layered, forming textura angularis (Fig. 24); outer layer 7–17 μm thick, 2–4 layers of melanized thick-walled, dark brown to black cells and with brown septate hyphae around the ascomata and necks, 2–2.5 μm in diam; inner layer 10–20 μm thick, 7–9 layers of hyaline to yellow brown, elongated cells which merge with the paraphyses. Paraphyses 5–19 μm wide, hyaline, septate and deliquescing early (Fig. 26). Asci 170–212 \times 15–25 μm (\bar{X} = 190.5 \times 19.7 μm , n = 30), eight-spored, cylindrical, pedunculate, unitunicate, persistent, truncate at the apex, with a non-amyloid apical thickening, with a limited number of asci in each ascoma at different developmental stages (Figs. 27–29). Ascospores 32–45 \times 15–18 μm (\bar{X} = 37.4 \times 16 μm , n = 50), ellipsoid, uniseriate, 3-septate, slightly constricted at the septa, central cells black, end cells smaller and hyaline to subhyaline (Figs. 30–33).

Type material: IMI 379749, Aug. 1998, on driftwood partially buried in sand, at the base of a sand dune, at Mornington Peninsula, Rye, Victoria, Australia, coll. E. B. G. Jones (Holotype).

Habitat: Saprobic on driftwood.

Distribution: Australia.

Ten *Savoryella* E. B. G. Jones & R. A. Eaton species have been described (Ho et al., 1997; Chang et al., 1998), of which, *S. lignicola* E. B. G. Jones & R. A. Eaton, *S. paucispora* (Cribb & J. W. Cribb) J. Koch, *S. longispora* E. B. G. Jones & K. D. Hyde and *S. appendiculata* K. D. Hyde & E. B. G. Jones are marine. *Savoryella melanospora* most closely resembles *S. aquatica* K. D. Hyde that was described by Hyde (1993b) on submerged wood in a freshwater river in Australia. *Savoryella melanospora* differs from *S. aquatica* in its marine habitat and in having larger ascomata, asci and ascospores (Table 3). The ascospores of *S. grandispora* K. D. Hyde are larger (46–58 \times 14–16 μm) than those of *S. melanospora*,

Table 3. Morphological comparison of *Savoryella aquatica* and *S. melanospora*.

	<i>S. melanospora</i>	<i>S. aquatica</i> (Hyde, 1993b)
Ascomata	160–305 μm high, 184–225 μm in diam, black	195–260 μm high, 91–130 μm in diam, brown
Neck	50–80 μm in diam	68 μm in diam
Asci	Cylindrical, 170–212 \times 15–25 μm	Cylindrical, 106–140 \times 26–34 μm
Ascospores	32–45 \times 15–18 μm (\bar{X} = 37.4 \times 16 μm), central cells fuscous, intensively black, end cells hyaline	29–38 \times 13.5–17 μm (\bar{X} = 33.5 \times 15.2 μm), central cells brown, end cells hyaline

dark brown in colour and the former is a freshwater species (Hyde, 1993b).

Discussion

In this preliminary study of the marine fungi on driftwood collected in a well-developed sand dune system in the Mornington Peninsula National Park, Rye, Australia, three new species were collected. Other fungi collected were: *Corollospora cinnamomea* J. Koch (5 collections), a *Diaporthe* species, *Leptosphaeria australiensis* (Cribb & J. W. Cribb) G. C. Hughes, *Aigialus* sp., *Linocarpon* sp., *Phoma* sp. and a discomycete with black apothecia. This suggests that we are dealing with marine sand dune fungi rather than a desert fungal community. Sand dunes are harsh habitats with exposed and buried wood subject to intense temperature variation, light intensity including UV, and subject to drying out at the collecting site. The sand dune vegetation was typical of the region and supports a number of low shrubs and herbaceous plants. Exposure to intense sunshine may account for the intense black colour (melanization) of the ascospores in the three species described in this paper, and the immersion of the bitunicate asci in *C. australiensis* and *P. scabridisporum* in a gelatinous matrix. The protection of asci in a gelatinous matrix is a feature of many bitunicate ascomycetes and discomycetes in mangrove habitats, where the ascmata are exposed for long periods, e.g. *Dactylospora haliotrepha* (Kohlm. & E. Kohlm.) Hafellner (Au et al., 1996; Kohlmeyer and Volkmann-Kohlmeyer, 1998), *Melaspilea mangrovei* Vrijmoed, K. D. Hyde & E. B. G. Jones (Vrijmoed et al., 1996) and many *Massarina* species (Read et al., 1994). The importance and role of this gelatinous matrix in the protection of developing sporulating structures warrants further investigation.

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