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Validation of three taxa of benthic marine algae from Brazil

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In addition to two previously described species, *Gelidiocolax pustulatus* E.C.Oliveira & Yoneshigue (Yoneshigue & Oliveira 1984, '*pustulata*') and *Peyssonnelia boudouresquei* Yoneshigue (Yoneshigue 1984), Yoneshigue (1985) proposed three further species designations. These are invalid because Yoneshigue's (1984) paper is a thesis that according to ICN Art. 30.9, Note 3 (Turland & al. 2018) is not an effective publication as it does not include "…an ISBN or the name of the printer, publisher, or distributor…" or an "…explicit statement that "… that it is regarded as an effective publication by its author…" required after 1 January 1953. Accordingly, "*Laurencia oliveirana* Yoneshigue", "*Peyssonnelia valentinii* Yoneshigue & Boudouresque", and "*Pseudolithoderma moreirae* Yoneshigue & Boudouresque", previously regarded as valid names are invalid designations that require validation.

Laurencia oliveirana Yoneshigue-Valentin, M.J.Wynne & Cassano, *sp. nov.* (Figs 1–10)

Diagnosis: Plants sub-erect, small-sized, up to 1.5 cm high, terete, reddish, forming intricate cushion-like tufts and unilateral pectinate branching. Creeping portion attached to the substratum by discoid holdfasts. Main axes, narrow, < 1 mm in diameter. Vegetative axial segments with four pericentral cells. Cortical cells secondarily pit-connected. Cortical cell walls not projecting near apex of branches and branchlets. Lenticular thickenings infrequent. Tetrasporangia tetrahedrally divided, formed at the end of the branches, produced from particular pericentral cells, with final arrangement in a parallel pattern in relation to the fertile axis.

Holotype: **RB** 752958 (YY 4016H) in herbarium of the Botanical Garden of Rio de Janeiro, Brazil, tetrasporophyte, collected 24 August 1983, *leg.* Y. Yoneshigue-Valentin (Fig. 11). Isotype: **SPF** 24767 in herbarium of the University of São Paulo, Brazil.

Type locality: Ponta da Cabeça, Arraial do Cabo, Rio de Janeiro, Brazil.

Other specimens examined (Paratypes): Ponta da Cabeça: YY 4014, January 1983; YY 4015H, April 1983. Ponta Leste, Cabo Frio: YY 3293H, April 1983; YY 3294H, January 1984.

Etymology: The specific name honours Dr Eurico Cabral de Oliveira for his extensive contributions to the knowledge of marine benthic algae of Brazil.

Description: Thalli forming cushion-like tufts up to 1.5 cm high, reddish in colour and fleshy in texture, adhering to herbarium paper when dried. Thallus entangled, consisting of terete axes formed of a creeping portion attached to the substratum by discoid holdfasts and an erect portion (Figs 1–3). The creeping axes are long and branched, 240–450 µm in diameter; apical portions can detach from the substratum and become erect (Fig. 3). Erect branches bend towards the substratum, 240–450 µm in diameter; they are naked at the base and bear unilateral secondary branches, 240–390 µm in diameter, always on their upper side, giving the plant a pectinate appearance. In surface view, cortical cells are polygonal in most portions of the thallus and become elongated towards the base. Each cortical cell in living plants has 1–2 (–3) *corps en cerise* (Fig. 4). In transverse section, cortical filaments are not arranged as a palisade, (18–) 21–24 (–30) µm long and 24–30 (–36) µm in diameter; medullary cells are rounded, (60–) 90–120 µm in diameter (Fig. 5); lenticular thickenings in medullary cells are occasionally present. Each vegetative axial segment cuts off four pericentral cells. In longitudinal section, cortical cells are connected to each other by longitudinally oriented secondary pit connections; outer cortical cell walls near apices are not projected beyond the surface (Figs 6–7). Trichoblasts are dichotomously branched (Fig. 8) and produced from the axial cell near the apex of the thallus. Tetrasporangia are produced at the end of the branches (Fig. 9) and inserted abaxially on an elongated fertile pericentral cell (Fig. 10). They are tetrahedrally divided and arranged parallel to the branch axis, (42–) 70–100 µm long and (30–) 60–75 µm in diameter.

Habitat: Specimens were collected on a rocky shore in the upper subtidal zone in site exposed to wave action in an upwelling region.

Distribution: This species is presently endemic to the Brazilian coast (Cassano & al. 2012; Hernández & al. 2017; Soares & al. 2018).

Reference *rbc*L sequence: JF810352, topotype, Brazil, Rio de Janeiro, Arraial do Cabo, Ponta da Cabeça, 07 July 2008, *leg.* V. Cassano and J.C. De-Paula (Cassano & al. 2012).

Notes: *Laurencia oliveirana* was inadvertently considered as validly published for a long time and was studied by both morphological and molecular approaches by several authors (Fujii 1990; Fujii & Sentíes 2005; Cassano & al. 2012; Hernández & al. 2017; Soares & al. 2018). The first molecular study based on *rbc*L gene for this species was performed by Cassano & al. (2012), which positioned it within *Laurencia sensu stricto*. A detailed account of tetrasporangial, female, and male specimens was provided by Cassano & al. (2012: 841–842, figs 1–23).

Pseudolithoderma moreirae Yoneshigue-Valentin, Boudouresque, M.J.Wynne & Cassano, *sp. nov.* Figs 12–20

Diagnosis: Thallus crustose, light to dark brown, ca. 15 mm in diameter, with lobed margins. Hypothallus unistratose with a polyflabellate arrangement, without rhizoids, from which arises erect filaments. Erect filaments juxtaposed forming a dorsal perithallus covered by a cuticle. Perithallus filaments simple or branched near base. Each filament with 15–23 cells, containing several discoid chloroplasts, 5–8 per cell. Phaeophycean hairs in tufts with basal growth, often deciduous. Unilocular structures ovoid forming indefinite sori covered by a cuticle, without paraphyses or sterile cells, developed from the terminal cells of the perithallus filaments.

Holotype: **RB** 784511 (YY 4066bisF) in herbarium of the Botanical Garden of Rio de Janeiro, Brazil, collected 14 April 1983, *leg.* Y. Yoneshigue-Valentin.

Type locality: Praia Rasa, Armação dos Búzios, Rio de Janeiro, Brazil.

Other specimens examined (Paratypes): Praia Rasa: YY 4065bisF, January 1983; YY 4067bisF, August 1983.

Etymology: The specific name honours Vice-Admiral Paulo de Castro Moreira da Silva (1919–1983), one of the pioneers of oceanography in Brazil.

Description: Thallus is in the form of spreading crusts, light to dark brown in colour, ca. 15 mm in diameter, with lobed margins (Fig. 12). Thallus thickness is 140–210 µm. Hypothallus creeping unistratose with a polyflabellate arrangement (Fig. 12) and without rhizoids, increases by marginal initials (Fig. 13), from which arise erect filaments forming a dorsal perithallus. Perithallial filaments are juxtaposed with each other (Figs 14–17). Each perithallial filament is composed of 15–23 cells in the central portion of the thallus, measuring 4–12 µm long and (5–) 6–9 (–13) µm wide. The perithallus is covered by a cuticle. Each cell of the perithallus contains 5–8 discoid chloroplasts (Fig. 18). The apical cells of the perithallus filaments, in superficial view, have a more or less hexagonal outline (Fig. 19). Perithallial filaments may be simple or branched near base and may end in phaeophycean hairs with basal growth (Figs 15, 16); these hairs shed easily, and after they are shed, a cavity in the thallus remains (Figs 15, 20). Unilocular structures arise on the surface of the thallus, forming indefinite sori without paraphyses or sterile cells; the sori are covered by a cuticle (Fig. 17). Unilocular structures arise directly from the terminal cells of the perithallial filaments; they are ovoid, measuring 15–23 µm long and 10–14 µm wide. Plurilocular structures were not observed.

Habitat: Specimens were collected on rocky shores in the intertidal zone at sites moderately exposed to wave action.

Distribution: The species appears to be endemic to the Brazilian coast.

Notes. It should be noted that even if Yoneshigue's (1985) thesis had been effectively published, *Pseudolithoderma moreirae* would have been an invalid name due to the lack of a Latin diagnosis, a requirement of the Code at that time (see Wynne 2017: 105). Overall, the genus *Pseudolithoderma* is poorly studied molecularly. Of the nine species currently considered taxonomically correct (Guiry & Guiry 2022), only *P. roscoffense* Loiseaux has been sequenced (Bittner & al. 2008). The genus requires further investigation, preferably using a combination of morphological and molecular data.

Agissea valentinii Yoneshigue-Valentin, Boudouresque, M.J.Wynne & Cassano, *sp. nov.* (Figs 21-33)

Diagnosis: Thallus fan-like, red, lobed and slender, prostrate, loosely attached to the substratum, fixed only at its centre by unicellular rhizoids. Basal calcification present. Hypothallus unistratose formed by parallel rows of cells. First perithallial cell wider than high, giving rise to 2 (–3) filaments of perithallus. Tetrasporangia in raised nemathecia irregularly distributed on the thallus surface; tetrasporangia cruciate, inserted on pedicel between branched paraphyses. Male sori lacking paraphyses. Spermatangia inserted in pairs on the terminal cells of perithallial filaments. Female plants with raised nemathecia formed by numerous and unbranched paraphyses. Carpogonial branches not observed. Auxiliary cell branches inserted on the basal cell of paraphyses. Carposporangia in three- to six-celled chains.

Holotype: **RB** 822598 (YY 4059F) in the herbarium of the Botanical Garden of Rio de Janeiro, Brazil, collected 5 February 1983, *leg.* Y. Yoneshigue-Valentin.

Type locality: Ponta do Maramutá, Ilha de Cabo Frio, Rio de Janeiro, Brazil.

Other specimens examined (Paratypes): Ponta do Maramutá: YY 4060F, YY 4061F, YY 4062F, all February 1984.

Etymology: The specific name honours Dr Jean Louis Valentin for his important contributions to marine biology and ecology of the coast of Rio de Janeiro.

Description: Thallus fan-like, red in colour, lobed and slender, brittle when bending it, 1–3 cm in diameter, attached to the substratum only at its centre (Figs 21, 22). Thallus thickness (45–) 60–105 (–135) µm at 1 mm from the margin. Hypobasal calcification present, (18–) 21–69 (–90) µm thick at 1 mm from the margin. Hypothallus unistratose, parallel in ventral view, cells rectangular to irregular, (18–) 21–34 (–36) µm long and 9–12 µm wide at 1 mm from the margin (Fig. 23). Unicellular rhizoids with median insertion on the cells of the hypothallus, (48–) 75–135 (–138) µm long and 6–13 µm wide at 1 mm from the margin (Fig. 24). First perithallial cell wider than high, formed above the hypothallial cell, gives rise to 2 (–3) filaments of perithallus, the filaments juxtaposed with each other (Fig. 25). Branching of the perithallial filaments was not observed in the tangential plane (Fig. 26). Perithallial filaments are inclined at angles of (45°–) 54°–80° (–86°) in relation to the plane of the hypothallus. Perithallial filaments formed by 2–7 cells. Perithallus secondary filaments absent. Seen from above, thallus has the initials of the perithallus arranged in radial rows (Figs 27–30). Cruciate tetrasporangia formed in irregular nemathecia raised above the thallus surface (Figs 31, 32). Paraphyses consist of 5–7 cells often bifurcate; bifurcation occurring from 1–2 (–5) cells from the base. Tetrasporangia are inserted on the last pedicel cell, 63–108 µm long and 21–51 µm wide, replacing paraphyses (Figs 32, 33). Male sori lack paraphyses (Fig. 34), spermatangia are inserted in pairs on the last cell of each perithallial filament, 30–60 µm long (Figs 35, 36). Female nemathecia are raised above the thallus surface higher than those of tetrasporangial nemathecia (Fig. 37). Nemathecia with numerous unbranched paraphyses consisting of an average of 8 cells (Fig. 38). Auxiliary cell branches are composed of 3 (more rarely 4) cells, inserted on the basal cell of a paraphysis (Figs

39, 40). Carpogonial branches were not observed, but connecting filaments indicate their presence (Fig. 41). Simple or single-branched gonimoblasts produce carposporangia in three- to six-celled chains (Fig. 38).

Habitat: Specimens were collected in subtidal zone from 1–4 m depth.

Distribution: The species is known only from the western Atlantic, Brazil and Bermuda (Schneider & Searles 1998; Schneider 2003; Wynne 2017, all as *Peyssonnelia valentinii* nom. inval.).

Notes: Yoneshigue's (1985) thesis included the invalid designation "*Peyssonnelia valentinii* Yoneshigue & Boudouresque". However, in recent years, research using gene-sequence methods revealed that multiple genera were included in the circumscription of *Peyssonnelia*. One such segregate genus is *Agissea* Pestana, Lyra, Cassano & J.M.C Nunes (in Pestana & al. 2021). Twelve species were assigned to *Agissea*, including the generitype *A. taberniforma* Pestana, Lyra, Cassano & J.M.C.Nunes. Phylogenetic analyses of *rbc*L sequences performed by Pestana & al. (2021) positioned thalli referable to as *P. valentinii* by Yoneshigue (1985) within the *Agissea* clade, which is phylogenetically distant to the authentic *Peyssonnelia* clade, showing a divergence of 11.2–14.9% (Pestana & al. 2021). As *Peyssonnelia valentinii* was not yet a validly published name, the nomenclatural transfer to the genus *Agissea* could not be carried out by Pestana & al. (2021). Sequences of specimens from the type locality are needed to verify the generic placement of this species.

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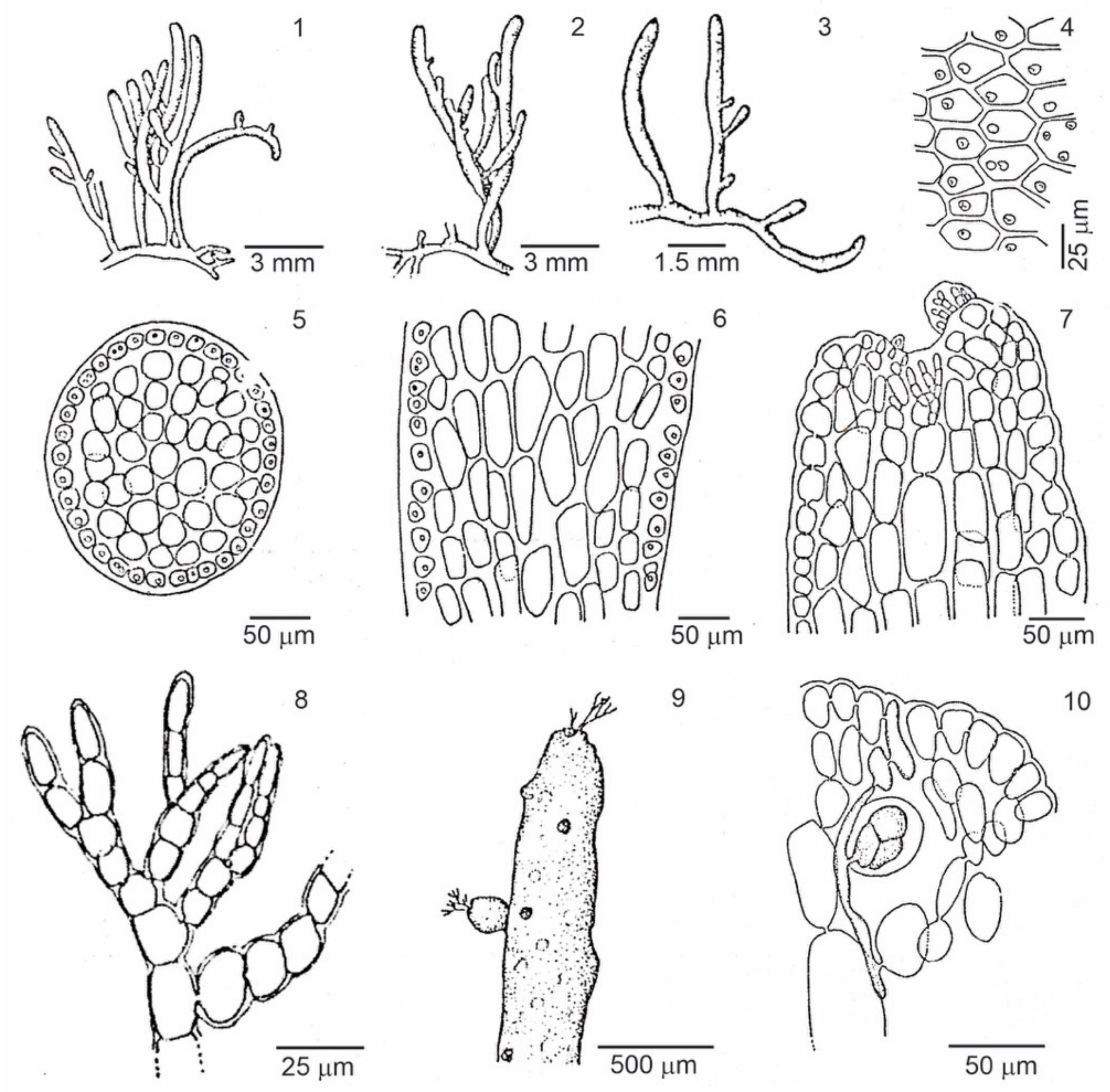
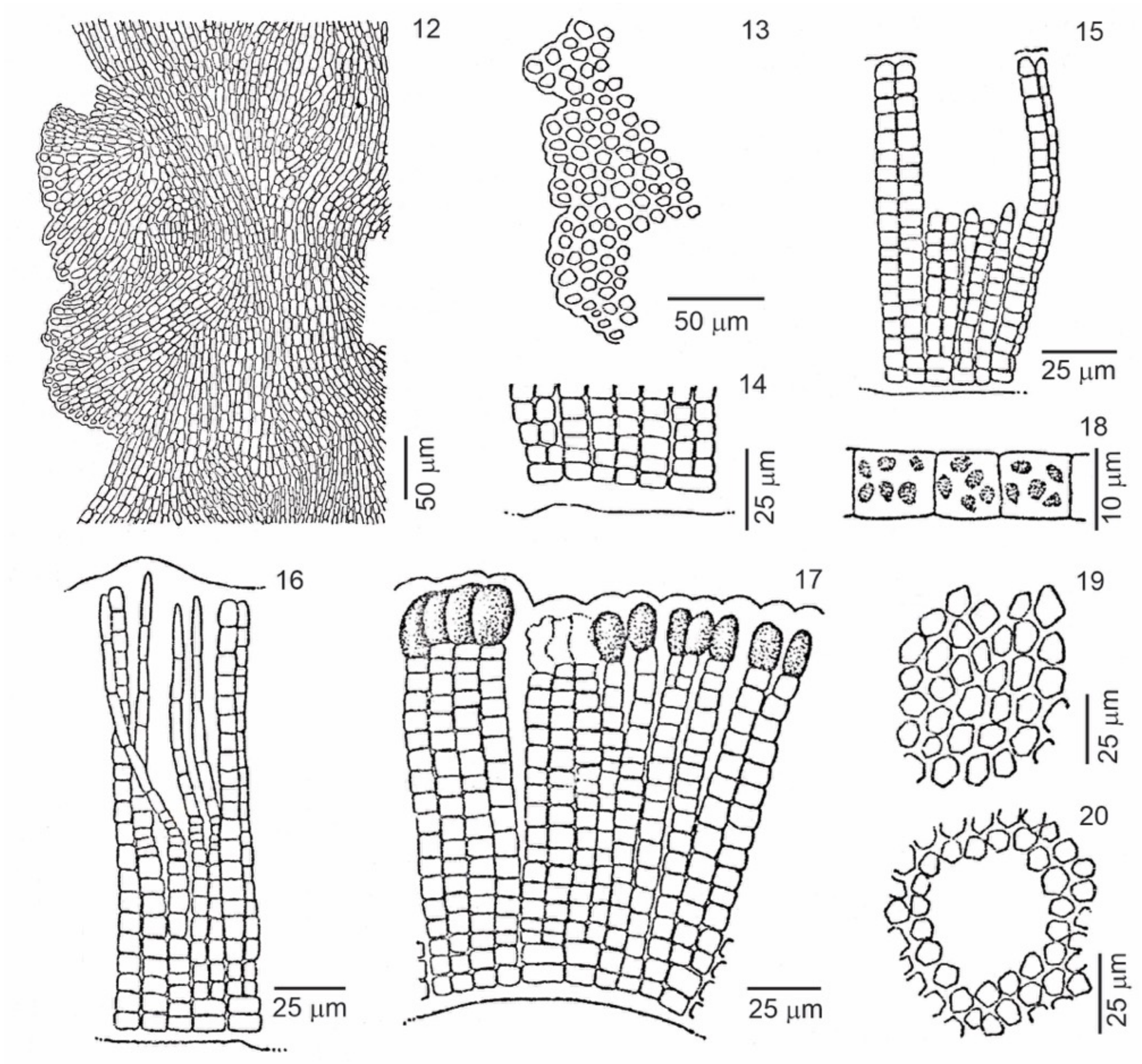
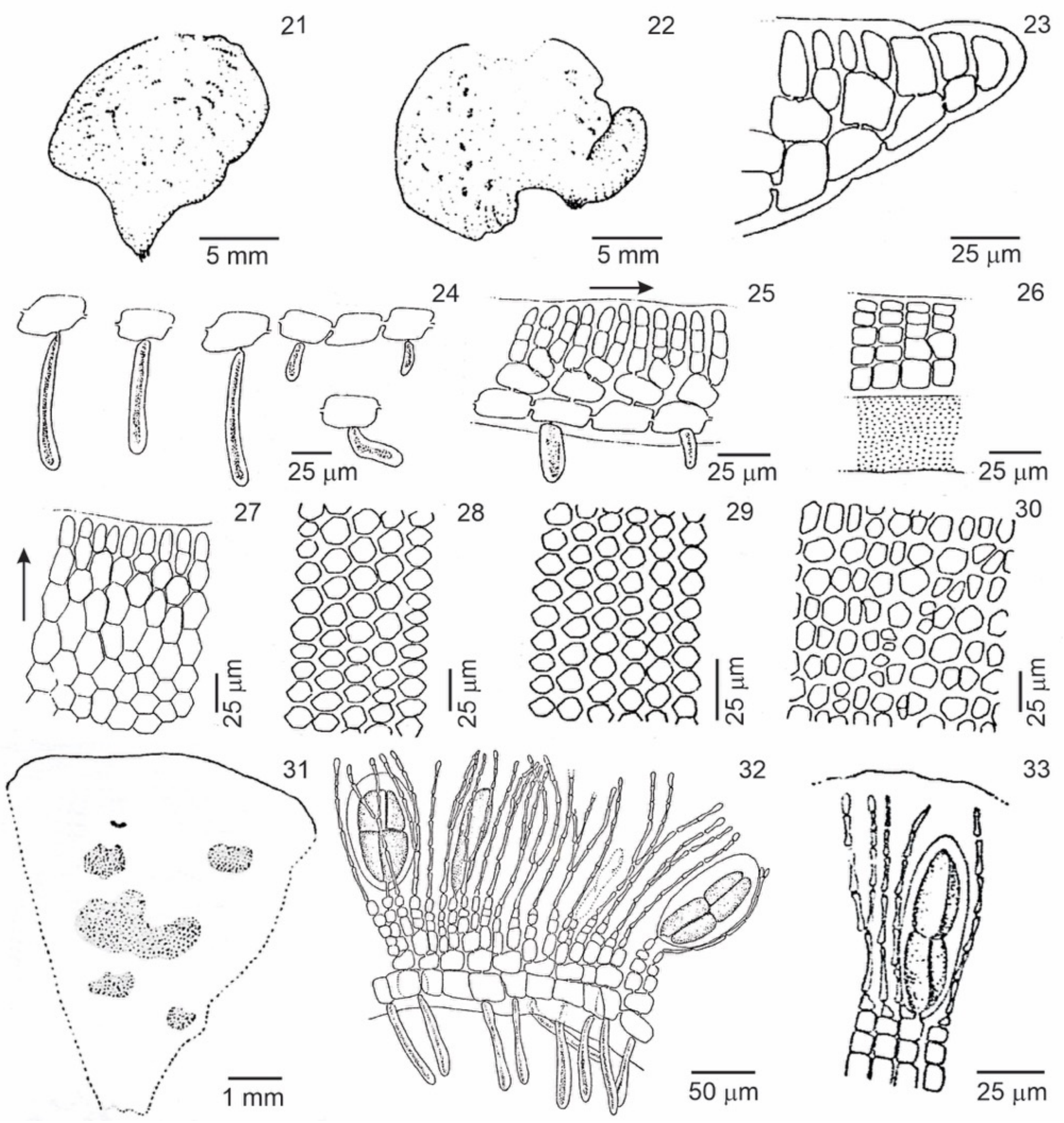


Figs 1–10. Representation of holotype material of *Laurencia oliveirana sp. nov*. **Figs 1–3.** Habit of the thallus. **Fig. 4.** Surface view of cortical cells showing *corps en cerise*. **Fig. 5.** Transverse section of the basal portion of an erect axis. **Fig. 6.** Longitudinal section of the middle portion of an erect axis. **Fig. 7.** Longitudinal section of the apical portion of an erect axis. Note secondary pit connections between cortical cells. **Fig. 8.** Detail of a trichoblast. **Fig. 9**. Apical portion of an erect axis with tetrasporangia. **Fig. 10.** Longitudinal section through a tetrasporangial branch showing fertile pericentral cell bearing an abaxial tetrasporangium.

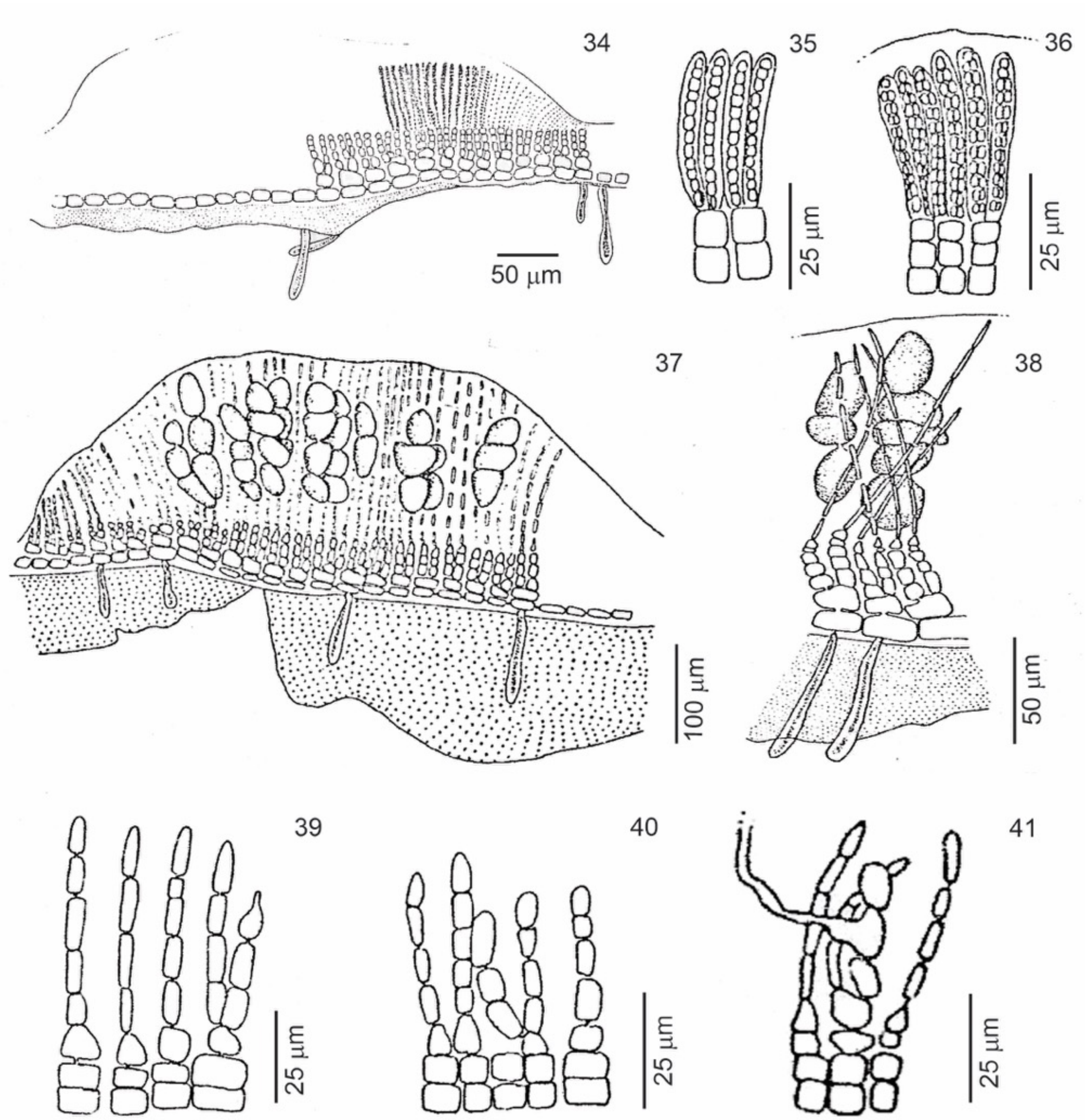
Fig. 11. Photograph of the holotype of *Laurencia oliveirana* **RB** 752958 (YY 4016H).



Figs 12–20. Representation of holotype and other material of *Pseudolithoderma moreirae sp. nov.* **Figs 12–13.** Holotype material. **Fig. 12.** Face view of the hypothallus with a portion of the margin. **Fig. 13.** Face view of the perithallus at the margin. **Figs 14–20.** Specimen YY 4065bisF. **Fig. 14**. Transverse section showing detail of the basal portion of erect filaments (perithallus). **Fig. 15**. Transverse section through the cavity left by a tuft of phaeophycean hairs after they are shed. **Fig. 16.** Transverse section through the phaeophycean hairs. **Fig. 17.** Transverse section through the mature thallus showing unilocular structures. **Fig. 18.** Transverse section showing detail of cells with chloroplasts. **Fig. 19.** Surface view from above. **Fig. 20.** Surface view from above of cavity left by a tuft of phaeophycean hairs after they are shed.



Figs 21–33. Representation of holotype material of *Agissea valentinii sp. nov.* **Figs 21–22.** Habit of the thallus. **Fig. 23.** Radial section through the margin. **Fig. 24.** Unicellular rhizoids. **Fig. 25.** Radial section at 450 µm from the margin (arrow indicates the direction of the margin). Note rectangular to irregular hypothallial cells. **Fig. 26.** Tangential section at 1 mm from the margin. **Fig. 27.** Face view of the perithallus at margin (arrow indicates the direction of the margin). **Figs 28, 29.** Face view of the perithallus at 1 mm from the margin. **Fig. 30.** Face view of the perithallus at 5 mm from the margin. **Fig. 31.** Thallus with tetrasporangial nemathecia. **Fig. 32.** Radial section through tetrasporangial nemathecium. **Fig. 33.** Detail of a tetrasporangium with paraphyses.



Figs 34–41. Representation of holotype material of *Agissea valentinii sp. nov.* **Fig. 34.** Radial section through spermatangial sorus. **Fig. 35.** Young spermatangia. **Fig. 36.** Mature spermatangia. **Fig. 37.** Radial section through female nemathecium. **Fig. 38.** Detail of carposporangia. **Figs 39–40.** Details of auxiliary cell branches in radial sections. **Fig. 41**. Detail of a connecting filament.