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Notes on some Hawaiian Ceramiaceae (Rhodophyceae), including two new species

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Two new species of Ceramiales from the Hawaiian Islands have been recorded, *Pleonosporium intricatum* sp. nov. and *Wrangelia elegantissima* sp. nov. Their distribution in Hawai'i and their possible relationships with other species in each genus are discussed. A new combination, *Ardreanema seriospora* (Dawson) comb. nov. is made, and *A. farifructa* Norris et Abbott is placed in synonomy with that species.

Key Index Words: Ardreanema—*Ceramiaceae*—*Ceramiales*—Plenosporium—*Rhodophyceae*—*taxonomy*—Wrangelia.

Although the Hawaiian benthic algal flora is quite well studied from various points of view, there still are species that have not been seen before appearing in collections. Also, there are species in this flora that have been known for many years under names that are incorrect. Such species in the Ceramiaceae, in particular, that I have discovered in the past two years of my investigations on Hawaiian Ceramiales require further description and taxonomic readjustments.

Materials and Methods

Herbarium specimens were dried either from freshly collected or formalin preserved material. Microscope slides were prepared from formalin fixed specimens, stained with aniline blue and mounted in a corn syrup medium. Number citations of specimens are preceded by letters that follow the code of Holmgren *et al.* (1981), except those preceded by IA which are in the collection of Dr Isabella Abbott at the University of Hawai'i at Manoa. It is expected that these specimens will eventually be housed in the Bishop Museum in Honolulu.

Results and Discussion

Pleonosporum intricatum R. E. Norris sp. nov.

Thalli epiphytici in algis maioribus, usque ad ca. 1 cm alti, cum ramis hospitis saepe intricati, interdum per rhizoidea adventitia affixi. Cellulae maturae adaxilalesque ca. 150×250 μm, parietibus inclusis usque ad 40 μm crassi; omnis cellula unum ramulum determinatum lateraleque ferens. Lateralia determinata in axe spiratim ordinata et divergentia ad angulum 60°C, pluribus ramis mediis ad distales, cellulis leviter et distaliter decrescentibus, apicibus ramorum adaxialiter recurvatis. Cellulae terminales omnium ramorum maturorum late rotundatae, ramis maturis aliquantum moniliformibus propter parietem incrassatum. Tetrasporangia adaxialia in cellulis ramulorum verticillorum prope extremitatem distalem ramulorum, ovoidea usque ad spheroidea, usque 40 μm diametro. Cystocarpia terminalia in ramulis verticillorum, plerumque aliquot gonimolobis evolventibus ad gradus encrementi dissimiles. Filamenta subtenta circum gonimolobos curvata et involucrum laxum formantia. Plantae masculae non inventae.

Thalli epiphytic on larger algae, up to approximately 1 cm tall, often entangled with

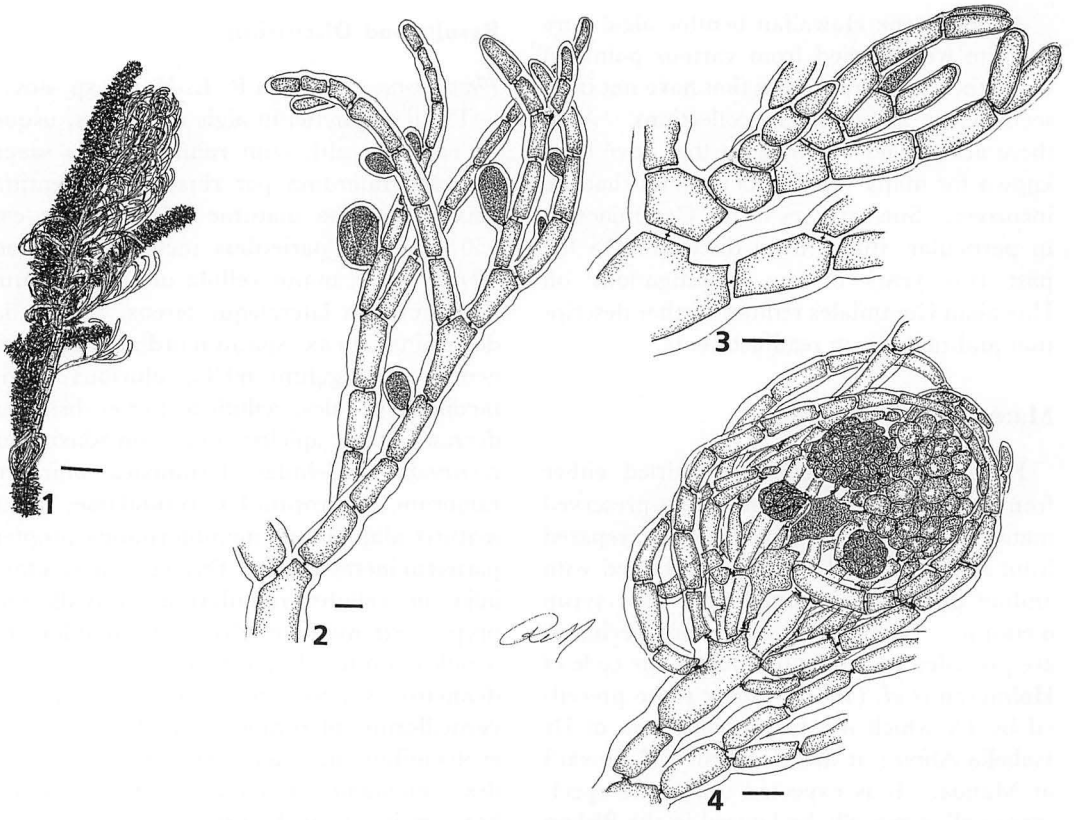
branches of host and may be attached in several places by adventitious rhizoids or curved branches (Fig. 1); mature axial cells approximately 150 × 250 μm, including walls up to approximately 40 μm thick, each cell bearing a single determinate lateral branchlet (Fig. 3); determinate laterals spirally arranged on axis at angles diverging approximately 60°C, having several mid to distal branches, cells slightly decreasing in size distally and with adaxially recurved branch tips (Fig. 2); terminal cells of all mature branches broadly rounded, mature branches appearing somewhat moniliform because of additional wall thickening. Tetrasporangia adaxial on whorl branchlet cells near distal end of branchlets (Fig. 2), ovoid to spheroid, up to 40 μm diameter. Cytocarps terminal on branchlets of whorl branchlets (Fig. 4), several gonimolobes at different stages of development usually present; subtending filaments curving around gonimolobes forming a loose involucre. Male plants not found.

Habitat: epiphytic on *Euptilocladia magruderi* Abbott et Norris, low intertidal to subtidal.

Holotype: BISH 539220 (Female), and isotype BISH 582021 (Tetrasporangiate), R. E. Norris 8621, 8622.

Hawaiian distribution: O'ahu Island, on a free-floating host, *Euptilocladia magruderi* Abbott et Norris, Lani Kai boatramp, Kailua Beach, 26, January, 1992, collected with S. fairres REN 8621, 8622.

Remarks: This new species is similar to *P. polymorphum* Itono (1971) but differs in having spirally arranged whorl branchlets instead of alternate distichously arranged branchlets in that species. Norris (1985) reviewed the



Figs. 1–4. *Pleonosporium intricatum*. Fig. 1. Habit of thallus on host, *Euptilocladia magruderi*. Scale bar = 150 μm. Fig. 2. A single lateral branchlet bearing a mature and several immature tetrasporangia. Scale bar = 25 μm. Fig. 3 Axis tip showing arrangement of young lateral branchlets. Scale bar = 10 μm. Fig. 4. Terminal cystocarp showing fusion cell bearing gonimolobes surrounded by involucral branchlets. Scale bar = 25 μm.

characters separating *Plenosporium* from related genera, particularly *Mesothamnion* Bφrgesen, concluding that female reproduction is the same in both genera and that production of polysporangia rather than tetrasporangia is not reliable in separation of these genera.

Etymology: *intricatus*=entangled, describing the way the curved branchlet ends which cause the epiphyte to become entangled with its filamentous host.

Wrangelia elegantissima R. E. Norris sp. nov.

Plantae fruticosae, usque and 10 cm altae, subtiliter ramosae ramis maioribus alternis pinnatisque. Axis vetustiores et partes proximales ramorum corticatae filamentis rhizoidalibus adhaerentibus et proximaliter crescentibus. Filaments transversa et laxe involventia ad nodos omnium ramorum. Apices ramorum proximaliter curvati. Ramuli 5 verticillorum ad omnem nodum, plerumque 1-2 maiores quam alii, illi longiores in latere adaxiali ramorum in nodis sequentibus dispositi. Ramuli breviores fortasse indeterminati sed illi longiores determinati. Omnes ramuli verticillorum subdichotome ramosi iterum atque iterum. Apices ramorum in cellulas 1-3 parvas acuminatas terminates quae fortasse deciduae sunt et apices ramuli rotundatos relinquunt. Tetrasporangia usque ad 75 μm diametro in ramis principalibus, brevioribus, determinatis et lateralibus; in cellulis proximalibus ramulerum verticillorum, laxe inclusa filaments 1-4 plerumque ramosis et involucralibus. Spermatangia in capitulis spheroideis ca. 90 μm diametro, circumcincta filamentis 3-4 ramosis et involucralibus. Cystocarpia in extremitatibus ramorum brevium lateralium. Gonimoblastus inter filamenta sterilia involucralia crescens. Ramuli verticillorum continui involucrum laxum formantes. Carposporangia ovoidea, ca. 40×75 μm.

Plants up to 10 cm tall, finely branched, bushy (Fig. 5), living plants often with a greenish tinge (foliage green to greyish green,

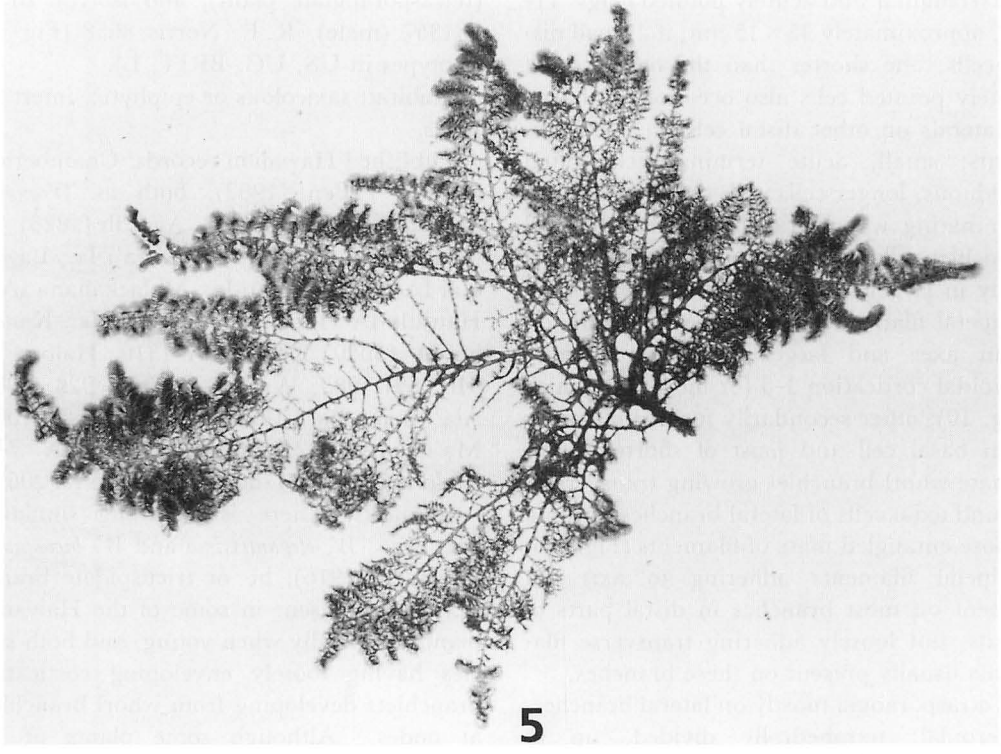


Fig. 5. Holotype specimen of *Wrangelia elegantissima* (BISH 631355). Natural size.

Kornerup & Wanscher 1978) and iridescent; dried specimens dark magenta to lilac (Kornerup & Wanscher 1978). Axial cells up to 500 μm wide, isodiametric to twice longer than broad; with 5(6) determinate branchlets (whorl branchlets) at each node, usually 2 large and 3 small, in opposite groups, sometimes 3 large and other times only one large branchlet per node (Fig. 7). Large whorl branchlets usually remaining determinate whereas smaller ones often are potentially indeterminate. Plants monopodial, lateral main branches alternate distichous (Figs. 5, 6), their apices curved in a proximal direction; laterals often potentially indeterminate branches growing mostly on adaxial side giving secund pattern to branch (Fig. 6); lateral branches also with distally directed (abaxial) longer whorl branchlets giving unequal appearance to thickness of laterals on branch (Figs. 5, 6). Whorl branchlets several times subdichotomously branched, proximal cells up to 40 μm diameter, distal end sometimes terminating in 1-2 small cells, the terminal one triangular and acutely pointed (Figs. 11-13), approximately 35 × 15 μm; if 2 small distal cells, one shorter than the other; small acutely pointed cells also occasionally borne as laterals on other distal cells in these filaments; small, acute terminal cells often deciduous, longer cells with obtuse ends then terminating whorl branchlets. Basal whorl branchlet cells often hour-glass shaped, especially in larger branchlets; developing broad basipetal filaments attached to axial cells on main axes and larger branches, forming rhizoidal cortication 1-3 (or more) cells thick (Fig. 10); other secondarily formed filaments from basal cell and most of shorter determinate whorl branchlet growing transversely around axial cells of lateral branches forming a loose entangled mass of filaments (Fig. 10); basipetal filaments adhering to axis not present on most branches in distal parts of plants, but loosely adhering transverse filaments usually present on these branches.

Tetrasporangia mostly on lateral branches, spheroidal, tetrahedrally divided, up to 75 μm diameter, on basal cells or other proximal cells of whorl branchlets often on short, abaxial branches (Fig. 14); loosely enclosed by 1-4 involucral filaments, 1-3 cells long, sometimes once branched, involucral cells approximately 15 μm diameter. Male heads spheroidal (Fig. 9), in similar positions to tetrasporangia, approximately 90 μm diameter, enclosed by 3-4 involucral filaments, each usually branching once or twice. Spermatangial mother cells fusiform to acerose (Fig. 8), approximately 25 μm long, producing ovoid spermatangia approximately 3.5 μm in diameter. Cytocarps terminating short lateral branches approximately 5 cells long, typical for Wrangelieae in having gonimoblast among narrow sterile involucral filaments, proximal cells in fertile branch producing loose outer involucral filaments; carposporangia terminal, ovoid, approximately 40 × 75 μm.

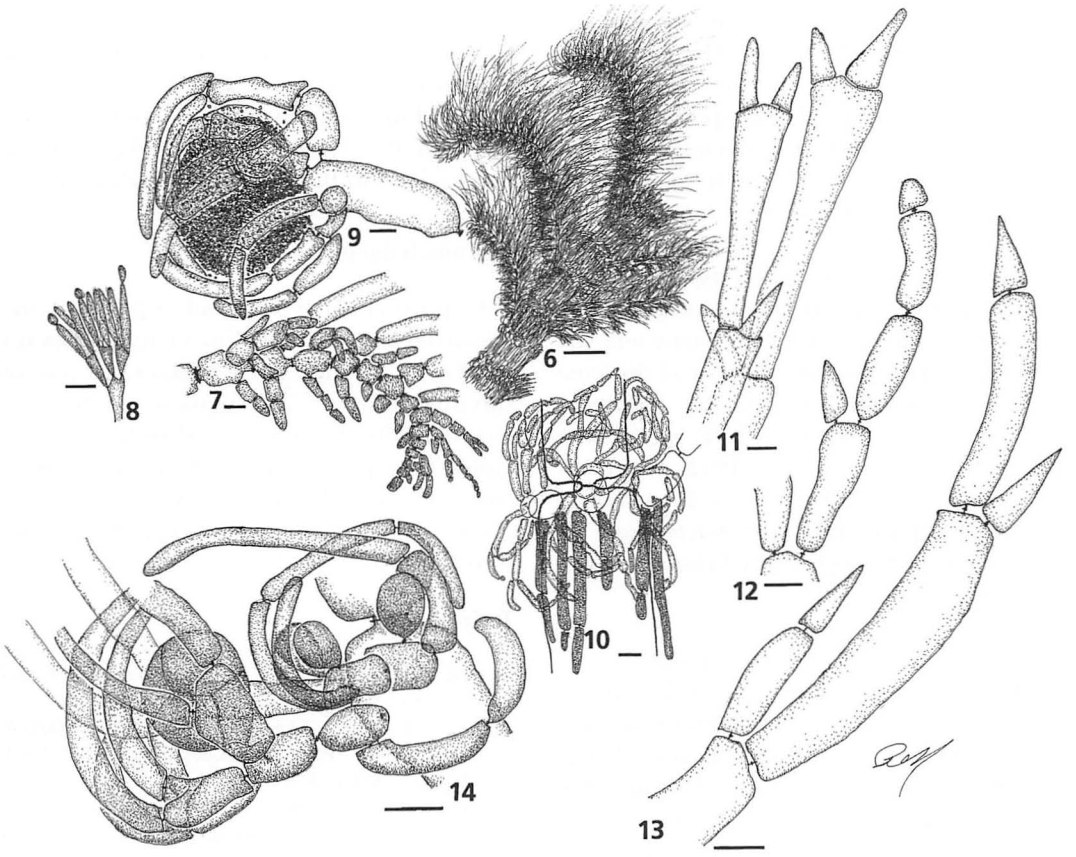
Holotype: Makapu'u Beach, O'ahu Island, Hawaii. On basalt rocks in upper intertidal pool, *legit* C. Smith, N. Phillips, & L. Walters, 2 May 1992 BISH 631355 (tetrasporangiate plant), and isotype BISH 631357 (male), R. E. Norris 8658 (Fig. 5). (Isotypes in US, UC, BRIT, L).

Habitat: saxicolous or epiphytic, intertidal pools.

Published Hawaiian records: Chamberlain (1880), Tilden (1902), both as *Wrangelia penicillata* (C. Agardh) C. Agardh (1828).

Hawaiian distribution; Kaua'i Is.: Lawai-Kai IA 20691; O'ahu Is.: Malaekahana IA 4, Hau'ula IA 1175, 1489, Coconut Is., Kaneohe IA 13050, Kaloko IA 1310, Halona IA 318, 591, 983, Waikiki IA 348, 928, 1087, Ala Moana Park 16242, Ewa Beach IA 1001, Ma'ili IA 1421, Kawela Bay IA 740; Molo'kai Is.: IA 17666, 'Ualapu'e IA 20657.

Remarks: There is a strong similarity between. *W. elegantissima* and *W. bicuspidata* Bφrgesen (1916), bi- or tricuspidate branch tips being present in some of the Hawaiian plants, especially when young, and both species having loosely enveloping corticating branchlets developing from whorl branchlets at nodes. Although some plants of *W. bicuspicata* from the Caribbean Sea, from



Figs. 6–14. *Wrangelia elegantissima*, showing habit and reproduction. Fig. 6. Axis with alternate distichous lateral branches. Note cortication on axis and uequal length of branchlets on abaxial and adaxial sides of lateral branches. Scale bar=325 μm. Fig. 7. Axis tip showing axial cell and arrangement of branches in early stage of development. Scale bar=20 μm. Fig. 8. Spermatangial mother cells, attached spermatia on three of them. Scale bar=10 μm. Fig. 9. Male capitulum surrounded by involucral filaments. Scale bar=10 μm. Fig. 10. Plant axis showing cortication at one node. Note heavily stippled corticating filaments grow basipetally and attached to the surface of the axial cells. Also note the loosely enveloping short, narrow-celled filaments that grow a short distance in both acropetal and basipetal directions. Scale bar=20 μm. Figs. 11–13. Determinate branch tips; Fig. 12. is a short branch tip. Fig. 11 scale bar=10 μm; Fig. 12 scale bar=13 μm; Fig. 13 scale bar=20 μm. Fig. 14. Lateral branchlets bearing tetrasporangia surrounded by involucral cells at a node. Scale bar=32 μm.

where it was originally described, have unequally developed whorl branchlets within nodes (personal observation), the tendency is not as strong as in *W. elegantissima* and usually does not result in flattened thalli as in the latter species. Also, *W. bicuspidata* has mostly four pericentral cells (whorl branchlets) whereas five or six are present in *W. elegantissima*, and the latter species has strong rhizoidal cortication on older axes that is not present in *W. bicuspidata*. Habitats of the two species are also different, *W. bicuspidata* being subtidal and *W. elegantissima* occurring intertidally.

Wrangelia elegantissima also resembles *W. tenuis* Noda (1964) in having 2 pairs of unequal whorl branchlets per node and in the production of transverse filaments forming a partial loose cortex around some axes. The larger size and different shape of the Hawaiian plant, the heavy axial cortication and secundate temporarily indeterminate branches and much longer whorl branchlets forming a much more villose plant in *W. elegantissima* are other characters distinguishing it from *W. tenuis* as well as *W. bicuspidata*.

There is also a superficial resemblance of *W. elegantissima* to *W. plumosa* Harvey (1844), as interpreted by Gordon (1972), but presence of involucral tetrasporangial filaments in *W. elegantissima* is a major character, among others, very different from this Australian species. A Chinese species of *Wrangelia, W. hainanensis* Tseng (1942), resembles *W. elegantissima* in having large, pinnately branched thalli and cuspidate apical cells on whorl branchlets, but other characters are different, particularly the absence of the loose cortication around nodes in *W. hainanensis* which is characteristic of both *W. elegantissima* and *W. bicuspidata*. Tseng (1942) noted that specimens on which Weber-van Bosse (1921) based her report of *W. bicuspidata* from the Malay Archipelago probably belonged to *W. hainanensis*.

Ardreanema Norris and Abbott (1992)

This genus contains a single species *Ardreanema farifructa*, an anomalous *Ceramium*-like alga that was found in Hawai'i. It was recently noticed, however, that Dawson (1963) had named this same taxon as a species of *Ceramium, C. seriosporum* Dawson, a new species he and his wife found in the Galapagos Islands. Dawson noted that some characters of his new species, particularly the uniseriate arrangement of carposporangia, were exceptional for *Ceramium* and suggested that it would possibly be separated into another genus. Norris and Abbott's new genus, *Ardreanema*, independently confirmed his prognosis. In light of the earlier description of this species, however, the following new combination is proposed, and, at the same time reducing *A. farifructa* Norris & Abbott into synonomy.

Ardreanema seriospora (Dawson) R. E. Norris comb. nov.

Basionym: *Ceramium seriosporum* Dawson, *Pacific Naturalist* 4(1): 13, Pl. 4, Figs. 1-6, 1963.

Synonym: *Ardreanema farifructa* R. E. Norris & I. Abbott (1992).

Type locality: "Epiphytic on crustose corallines with *Antithamnion veleroae* Taylor, intertidal on the seaward side of Isla Cuamaño, Academy Bay, Santa Cruz Island, Galapagos Archipelago." (Dawson 1963).

World distribution: Hawai'i and Maui Islands in the Hawaiian Archipelago, Santa Cruz Island in the Galapagos Archipelago.

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Richard E. Norris：2 新種を含む数種のハワイ産紅藻イトグサ科藻類について

ハワイ諸島からイトグサ目の 2 新種，*Pleonosporium intricatum* と *Wrangelia elegantissima* を記載した。これらの種のハワイにおける分布とそれぞれの種の同属の種との関係につき議論した。また，*Ardrenema seriopora* (Dawson) Norris の新組み合わせを提唱し，*A. farifructa* Norris et Abbott を本種の異名とした。(Botanical Research Institute of Texas, 509 Pecan St., Fort Worth, Texas, U.S.A. 76102–4060.)

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