Notes on the benthic marine algae of Puerto Rico VIII. Additions to the flora

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Abstract

Ten species of benthic algae, principally associated with coral reef habitats, are newly reported for the Puerto Rican marine flora. These include eight Rhodophyta: *Renouxia antillana, Lithophyllum congestum, Lithothamnion occidentale, Metapeyssonnelia corallepida, Maripelta atlantica, Pihiella liagoraciphila, Antithamnionella graeffei, and Myriogramme prostrata; one Heterokontophyta: Dictyota pfaffii; and one Chlorophyta: Caulerpa nummularia. Maripelta atlantica and Myriogramme prostrata are additionally reported for the Cayman Islands and from Venezuela, respectively.*

Keywords: algal flora; Caribbean Sea; Puerto Rico.

Introduction

Despite the fact that the marine algal flora of Puerto Rico is the best known of any Caribbean island, both offshore and inshore collections are continuously yielding new species (Aponte and Ballantine 1990, 1995, Ballantine 1990, 2000, 2004, Ballantine and Wynne 1988, Wynne and Ballantine 1991, Ballantine and Norris 1994, Norris and Ballantine 1995, Huisman et al. 2001, Lopez-Cabrera and Ballantine 2001, Ballantine et al. 2002a) and new species records (Ballantine and Norris 1989, Ballantine and Aponte 1997, Ballantine and Wynne 1998, Ballantine et al. 2002b). Including the additions reported herein, 502 species of algae, including macroscopic Chrysophyceae and Xanthophyceae but excluding Cyanophyta, are now known from the marine waters surrounding Puerto Rico (Ballantine and Aponte 2002). Continued collection of algae around the island, principally focused on deep and shallow coral reef habitats, has led to the recognition of ten species additionally known for the flora.

Materials and methods

Collections were made with the use of SCUBA or by snorkeling. Specimens of all species have been deposited in the Herbarium of the Department of Marine Sciences, University of Puerto Rico at Mayagüez (MSM). Microscopic preparations were stained with 1% acidified aniline blue and photomicrographs were taken with a SPOT RE digital camera (Diagnostic Instruments, Sterling Heights, USA) through an Olympus BMAX light microscope (Olympus Optical Co., Tokyo, Japan). Plates were assembled using Adobe[®] Photoshop[®] 7.0 (Adobe Systems Inc., San Jose, USA). Authority abbreviations follow Brummitt and Powell (1992).

Results and discussion

Rhodophyta, Rhodophyceae, Rhodogorgonales, Rhodogorgonaceae

Renouxia antillana Fredericq et J.N. Norris (Figure 1): *DLB* 5935, Punta Brea, Guanica (17° 54.592' N, 66° 56.445' W), 16.0 m, Coll. D.L Ballantine, H. Ruiz, 3.ix.2003.

Puerto Rican plants when living are mostly chalky white with pinkish margins. The thalli are highly lubricous and measure to 7 cm tall, with flattened branches, 1 to 2 mm thick, 4 to 8 mm broad. The axes are largely complanate. The type locality of the species is llet à Caret, Guadeloupe, French West Indies (Fredericq and Norris 1995). Fredericq and Norris (*op. cit.*) also indicated that *Renouxia antillana* is known from the Greater and Lesser Antilles as well as Jamaica. The species has also been reported from Fiji in the Pacific (N'Yeurt 2001).

Corallinales, Corallinaceae

Lithophyllum congestum (Foslie) Foslie (Figures 2, 3): *DLB s.n.*, Margarita Reef, La Parguera (17° 55.159' N, 67° 06.112' W), 2.0 m, Coll. D.L.B., 7.iv.1976; *DLB 6005*, Enrique Reef, La Parguera (17° 57.294' N, 67° 02.608' W), 3.0 m, Coll. H.R., 28.x.2003.

Erect compressed branches are closely arranged, giving the entire colony a cerebriform appearance when viewed from above (Figure 2). Branches measure 1.5 to 2.5 mm in thickness and are up to 1.0 cm broad; however, fused branches measure to 3.0 cm broad. The entire colonies are 45 mm in height (Figure 3). Littler and Littler (2000) reported that *Lithophyllum congestum* is abundant in shallow water, wave impacted coral reefs in the Caribbean. Despite being a common coral reef element in Puerto Rico, it has not previously been reported for the flora.

Lithothamnion occidentale (Foslie) Foslie (Figure 4): *DLB 1263*, Margarita Reef, La Parguera (17° 54.180' N, 67° 06.320' W), 24 m, Coll. D.L.B., 13.v.1983; *DLB 2348*, *ibid.*, 18.xii.1986.



Figures 1–7 (1) Underwater photograph of *Renouxia antillana*. Approximate field=15 cm. (2–3) *Lithophyllum congestum*. (2) View from top. (3) Lateral view. Scale bar for both figures=1.0 cm. (4) Habit of *Lithothamnion occidentale*. Scale bar=1.0 cm. (5–7) *Maripelta atlantica*. (5) Habit of plant; arrows denote abscission zones. Scale bar=5.0 mm. (6) Cross section; arrows denote secondary growth of cortex. Scale bar=250 μ m. (7) Longitudinal section; arrows denote abscission zone. Scale bar=250 μ m.

Lithothamnion occidentale was collected growing unattached on the bottom. Individual colonies measure to 5 cm in diameter and to 3 cm in height. Colony branching is to several orders with branch diameters ranging from 1.4 to 2.0 mm. Taylor (1960) reported the presence of the species from Florida, Hispaniola, the U.S. Virgin Islands and Netherlands Antilles. Schneider and Searles (1991) also reported the species from North Carolina and Diaz-Piferrer (1970) further reported the species from Venezuela.

Gigartinales, Peyssonneliaceae

Metapeyssonnelia corallepida M.Verlaque, Ballest. *et* Antonius: *DLB 6038*, San Cristobal Reef, La Parguera (17° 56.497' N, 67° 04.497' W), 2 m, Coll. H.R., 9.xii.2003;



Figures 8–11 (8) *Pihiella liagoraciphila.* Habit of two individuals endophytic in *Liagora* sp. Scale bar=50 μ m. (9) Habit of tetrasporophytic *Antithamnionella graeffei*. Scale bar=100 μ m. (10–11) *Myriogramme prostrata.* (10) Apical region showing marginal teeth. Scale bar=250 μ m. (11) Lateral portion of blade showing marginal rhizoids. Scale bar=250 μ m.

D.L.B. 6127, *ibid.*, 21.i.2004; *D.L.B.* 6125, Laurel Reef, La Parguera (17° 56.617′ N, 67° 03.305′ W), 2 m, Coll. H.R., 21.i.2004.

Plants were observed forming extensive carpets over living *Millepora complanata* (Lam.) and on coral rubble. Algal growth on these substrata is 450 to 590 μ m in thickness. The hypothallial filaments are distinctly fanshaped in arrangement and possess one-celled rhizoids. Hypothallial and perithallial cell dimensions are within and tetrasporangial dimensions are at the low end of the ranges reported for the species by Verlaque et al. (2000). *Metapeyssonnelia* is unique in having a *Peyssonnelia*-like cellular arrangement seen in radial section, which may change locally to what Boudouresque et al. (1976) referred to as a fountain-like structure.

The type locality for the species is Key Largo, Florida and it is also known from collections in Belize, Central America (Verlaque et al. 2000). Antonius and Ballesteros (1998) indicated that *Metapeyssonnelia corallepida* was capable of overgrowing *Porites* spp. as well, and the alga begins growth at the base of coral colonies where there is no living coral tissue. Antonius (1999) reported that, following overgrowth of the living coral, there was no longer live coral tissue beneath the *Metapeyssonnelia*.

Rhodymeniales, Rhodymeniaceae

Maripelta atlantica Eiseman *et* R.L.Moe (Figures 5–7): *DLB 5715*, Isabella (18° 30.939' N, 67° 05.889' W), 12 m, Coll. H.R., 2.ix.2002.

The single Puerto Rican plant measures to 16 mm high with a terminal peltate blade, measuring to 4 mm across. The stipe, varying in diameter from 1.0 to 1.5 mm, possesses conspicuous annular scars. The scars result from regrowth following blade loss (Eiseman and Moe 1980). Eiseman and Moe (1980) separated *Maripelta atlantica* from *M. rotata* (E.Y. Dawson) E.Y. Dawson (1963) on the basis of tetrasporangial nemathecia. While the Puerto Rican plant was sterile, and despite its smaller overall size, we assign the Puerto Rican entity to the only other

species known from the western Atlantic. Presence of the species is also noted for the north coast of Grand Cayman Island [*DLB* 5855, 20 m, Coll. H.R., 6.xii.2002].

Pihiellales, Pihiellaceae

Pihiella liagoraciphila Huisman, A.R. Sherwood *et* I.A. Abbott (Figure 8): *DLB* 5510b, Leeward Media Luna Reef, La Parguera (17° 56.310' N, 67° 02.984' W), 1.0 m, endophytic in *Liagora* sp., Coll. H.R., 25.i.2001.

Until Huisman et al. (2003) formally described the genus and species, these enigmatic plants from the Caribbean were considered to be "monosporangial discs" (Howe 1920). Puerto Rican plants are endophytic within *Liagora* thalli and measure 40 to 150 μ m in diameter. The species is recognized from Hawaii, Japan and Australia in the Pacific (Huisman et al. 2003) and Jamaica (Howe 1920) and St. Croix, U.S. Virgin Islands (Børgesen 1920) in the Caribbean.

Ceramiales, Ceramiaceae

Antithamnionella graeffei (Grunow) Athanas. (Figure 9): DLB 5623b (=H.R. 223), Media Luna Reef, La Parguera (17° 56.096' N, 67° 02.911' W), 8.2 m, epiphytic on Chrysymenia sp., Coll. H.R., 2.xi.2001.

Plants grow from prostrate axes to 30 μ m in diameter, decreasing in diameter towards the apices, where branchlets measure to 17 μ m in diameter. Algae are attached by elongate unicellular rhizoids which are cut off from periaxial cells. Axes cut off three whorl branchlets per segment, with the periaxial cells being shorter than the contiguous and distal cells. The whorl branchlets, 9 to 11 µm in diameter, are simple or to twice subdichotomously branched. Gland cells cover a single whorl branchlet cell, measuring 20 to 23 μm long and to 12 μm broad. The gland cells are situated towards the proximal ends of the whorl branchlets and at the base of whorl branchlet dichotomies. Only tetrasporangial plants were found, and tetrasporangia are cruciately divided and oblong, measuring to 50 μ m long and to 28 μ m broad. The tetrasporangia are principally cut off by periaxial cells; however, they are also cut off from the next distal whorl branch cell. Schneider and Searles (1997) observed that tetrasporangial plants from Bermuda lacked gland cells; however, these are abundantly produced by the Puerto Rican plants.

In the western Atlantic Antithamnionella graeffei is known from the U.S. Virgin Islands (Abbott 1979) and North Carolina (Schneider 1984) as Antithamnionella flagellata (Børgesen) I.A. Abbott (1979) and from Brazil (Joly et al. 1963, as Antithamnion tristicum A.B. Joly et Yam.-Tomita). Schneider and Searles (1997) later reported Anithamnionella graeffei from Bermuda. Additional reports of the species are from Tonga Island, the type locality, and Mauritius (Indian Ocean), Elat, Israel (Red Sea), Tryon Island (Queensland, Australia) and the Houtman Abrolhos Islands (Børgesen 1945, Athanasiadis 1996, Huisman 2000).

Delesseriaceae

Myriogramme prostrata (E.Y. Dawson, Neushul et Wildman) M.J. Wynne (Figures 10, 11): DLB 6029, Turrumote Reef, La Parguera (17° 56.097' N, 67° 01.130' W), 11 m, Coll. H.R., 31.x.2003.

The alga was locally abundant in a turf community associated with a coral reef habitat. Blades measure to 250 μ m across and possess numerous marginal rhizoids (Figure 11) which attach to the substratum as well as other blades resulting in a single coherent mass. Puerto Rican plants were tetrasporophytic with tetrasporangia in discrete scattered sori. Sporangia measure to 80 μ m in diameter. Marginal teeth are common on the blades (Figure 10) and plants agree closely with the account provided by Wynne (1990).

Myriogramme prostrata is known from its type habitat, Baja California Mexico (Dawson et al. 1960) and is known in the western Atlantic from Costa Rica (Wynne 1990). Presence of the species is also noted for a collection from Venezuela (*DLB 4557*, 1.0 m, Bequebé Is., Los Roques, 20.vii.1992). Littler and Littler (2000) further indicated the species' presence from the Lesser Antilles.

Heterokontophyta, Phaeophyceae, Dictyotales, Dictyotaceae

Dictyota pfaffii Schnetter: *DLB 6046*, edge of insular shelf, offshore La Parguera (17° 53.423' N, 66° 59.320' W), Coll. D.L.B., 23.xii.2003, 22 m.

Dictyota pfaffii was originally described from Colombia in the southern Caribbean, from shallow water (Schnetter 1972). It is a common member of the deep-reef algal community in Puerto Rico, where thalli grow decumbent over a variety of substrata at the edge of the insular shelf and are brilliantly iridescent when alive. Sporangia are scattered over the upper surfaces, measuring to 90 μ m in diameter. Medullary and cortical cell dimensions as well as branching angle are within the ranges reported in Hörnig et al. (1992) for D. humifusa Hörnig, Schnetter et Coppejans; however, Bula-Meyer (1994) provided evidence for the conspecificity of these species. Hörnig et al. (1992) indicated that the species (as D. humifusa) is known from the northern tropical to subtropical western Atlantic as well as from the East African coast. Littler and Littler (2000) maintained D. pfaffii and D. humifusa as separate taxa and reported their presence in the western and southern Caribbean from shallow to deep-water.

Chlorophyta, Chlorophyceae, Caulerpales, Caulerpaceae

Caulerpa nummularia Harvey ex J. Agardh: *DLB 6003*, Romero Reef, La Parguera (17° 56.830' N, 66° 59.431' W), Coll. H.R., 27.x.2003, 8.2 m.

Peltate branchlets measure to 4.5 mm across, and possess slight scalloping on the margins. The proliferating assimilators frequently originate from the center of peltate branchlets. Rhizomes measure to 0.6 mm in diameter. While otherwise similar to *Caulerpa racemosa* (Forssk.) J. Agardh var. *peltata* (J.V. Lamour.) Eubank, the above characters differentiate the two species. *Caulerpa nummularia* is known from the Hawaiian Islands (Abbott and Huisman 2004), Ceylon (Svedelius 1906), Tanzania (Jaasund 1977), Mauritius (Børgesen 1946). The only other report for the species in the western Atlantic was from Belize by Littler and Littler (1997).

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