Nova Hedwigia **76** 1—2 113—127 Stuttgart, Februar 2003

# An annotated checklist of deep-reef benthic marine algae from Lee Stocking Island, Bahamas (western Atlantic), I. Chlorophyta and Heterokontophyta

by

David L. Ballantine* and Nilda E. Aponte

Department of Marine Sciences, University of Puerto Rico, P.O. Box 9013, Mayagüez, Puerto Rico 00681

With 4 figures

Ballantine, D.L. & N.E. Aponte (2003):An annotated checklist of deep-reef benthic marine algae from Lee Stocking Island, Bahamas (western Atlantic), I. Chlorophyta and Heterokontophyta. - Nova Hedwigia 76: 113-127.

**Abstract:** Forty two Chlorophyta and nine Heterokontophyta (Phaeophyceae) species of benthic marine algae were identified from collections made at the deep (> 27 m) fore-reef at Lee Stocking Island, Bahamas. Ten of these species represent first reports from the Bahamas Archipelago and the report of *Pedobesia simplex* (Meneghini ex Kützing) M.J.Wynne & F.Leliaert is probably the first authentic record from the western Atlantic. Collected at depths of 61 m, *Avrainvillea cyathiformis* sp. nov. is described herein. The new species attains a height of only 4.0 cm and has nearly cylindrical inner medullary filaments which measure to 20 µm in diameter. The filaments decrease in diameter, to 8 µm, at their distal ends and are tortuous. *Avrainvillea cyathiformis* differs from all other species of the genus in possessing cyathiform blades.

**Key words:** *Avrainvillea*, Bahamas, coral reef algae, deep-water algae, submersible, western Altantic.

## Introduction

A number of deep-water studies of benthic algae in the tropical/subtropical western Atlantic have taken advantage of both SCUBA diving and submersibles. Submersible collections have resulted in the characterization of a number of new species and distributional records for the region (Eiseman & Moe 1981; Eiseman & Norris 1981; Eiseman & Blair 1982; Eiseman & Earle 1983; Littler et al. 1985; Hanisak et al. 1987; Hanisak & Blair 1988a; Blair & Norris 1988; Norris & Olsen 1991; Bucher &

*Corresponding author: E-Mail: d_ballantine@rumac.upr.clu.edu

DOI: 10.1127/0029-5035/2003/0076-0113 0029-5035/03/0076-0113 $ 3.75

Norris 1992; Ballantine & Norris 1994; Ballantine & Aponte 1996; Wynne & Schneider 1996). Between October 1992 and May 1995, we had the opportunity to study the deep-water algal flora at Lee Stocking Island in the Bahamas archipelago, utilizing SCUBA and submersible collections. Results of this work in which depth distribution and abundance of the common algal elements recognizable from a submersible have been reported (Aponte & Ballantine 2001). This communication reports benthic Chlorophyta and Heterokontophyta algal species identified from 11 SCUBA collections and collections made from 106 submersible dives. Many of the species records herein represent the deepest distributional reports known as well as new geographic distributional records for the Bahamas.

## Materials and methods

Sampling utilized SCUBA diving and the two-manned submersible *DSV Nekton-Gamma* leased by the Caribbean Marine Research Center (CMRC) of the NOAA National Underwater Research Program (NURP). The submersible was towed to site at the insular shelf break, east of Lee Stocking Island and launched from the *R/V Bahama Hunter*. Submersible dives were made on two previously established transects: AA, 23°4746'N and 76°0585'W, and BA, 23°4678'N and 76°0500'W (see fig. 1 in Aponte & Ballantine 2001). The submersible, with operating depths to 300 m, was equipped with an hydraulically-manipulated mechanical arm with claw which allowed sampling of small to medium-sized dislodged pieces of substratum (3-10 kg). Collected samples were brought to the surface in an externally mounted bag or basket, or were held in the manipulator claw for the duration of the dive. Specimens were preserved in 10% formalin-seawater.

Photomicrographs using Kodak Pan Technical black and white film were taken through an Olympus BMAX light microscope. Voucher specimens have been deposited in the University of Puerto Rico Herbario Marino Puertorriqueño (MSM). Species authority designations are according to Brummitt & Powell (1992). Geographic distributional records are indicated with asterisks (*).

## Heterokontophyta: Phaeophyceae, Sporochnales, Sporochnaceae

**Nereia tropica* (W.R.Taylor) W.R.Taylor

D.L.B. 5209, Transect BA, v.1995, 27 m.

The species was previously known only from Florida, Bermuda and Jamaica, and has been reported as dredged from a maximum of 55 m (Taylor 1955, 1960).

## Sphacelariales, Sphacelariaceae

**Halopteris filicina* (Gratel.) Kütz. Fig. 1

D.L.B. 5070, Transect BA, 4.v.1995, 76 m.

Known only from the eastern Atlantic until Hanisak & Blair (1988a) reported the species from deep-water in Florida (46-98 m), this represents only the second report of the species in the western Atlantic.

**Dictyotales, Dictyotaceae**

*Dictyopteris delicatula* J.V.Lamour.

D.L.B. 4916, Transect BA, 31.viii.1994, 61 m; D.L.B. 4961, Transect BA, i.1995, 61 m.

Despite the fact that *Dictyopteris delicatula* is an extremely common species throughout the Caribbean, particularly in shallow water, it has only been reported from the Bahamas previously by Littler & Littler (2000). Macintyre et al. (1991) reported the species to a depth of 74 m based on submersible collections in Barbados.

*Dictyota bartayresiana* J.V.Lamour.

D.L.B. 4780, Transect BA, 22.ix.1993, 30 m; D.L.B. 4952, Transect BA, i.1995, 61 m; D.L.B. 5006, Transect AA, i.1995, 46 m.

Hanisak & Blair (1988a) reported the species to a depth of 54 m based on submersible collections in Florida.

*Dictyota cervicornis* Kütz.

D.L.B. s.n., Transect AA, 17.x.1992, 31 m; D.L.B. 4579, Transect AA, 14.iv.1993, 77 m.

*Dictyota pulchella* Hörnig & Schnetter

D.L.B. 4898, Transect BA, 31.viii.1994, 61 m; D.L.B. 4951, Transect BA, i.1995, 61 m; D.L.B. 5101, Transect BA, 4.v.1995, 61 m; D.L.B. 5202, Transect BA, 4.v.1995, 76 m

Hanisak & Blair (1988a) reported this species (as *D. divaricata* J.V.Lamour.) to 58 m in Florida.

*Lobophora variegata* (J.V.Lamour.) Womersley ex E.C.Oliveira

D.L.B. 4341, Transect AA, 17.x.1992, 31 m; D.L.B. 4576, Transect AA, 14.iv.1993, 77 m; D.L.B. 4796, Transect AA, 22.ix.1993, 61 m; D.L.B. 4913, Transect BA, 31.viii.1994, 61 m; D.L.B. 4987, Transect AA, i.1995, 91 m; D.L.B. 5057, Transect BA, 5.v.1995, 107 m; D.L.B. 5187, Transect BA, 4.v.1995, 76 m.

Hanisak & Blair (1988b) reported *Lobophora variegata* to 90 m from San Salvador Island, Bahamas and Littler & Littler (2000) indicated that the species has been collected to 120 m.

*Stypopodium zonale* (J.V.Lamour.) Papenf.

D.L.B. 5214, Transect BA, v.1995, 27 m.

Littler & Littler (2000) indicated a maximum depth for the species of 80 m.

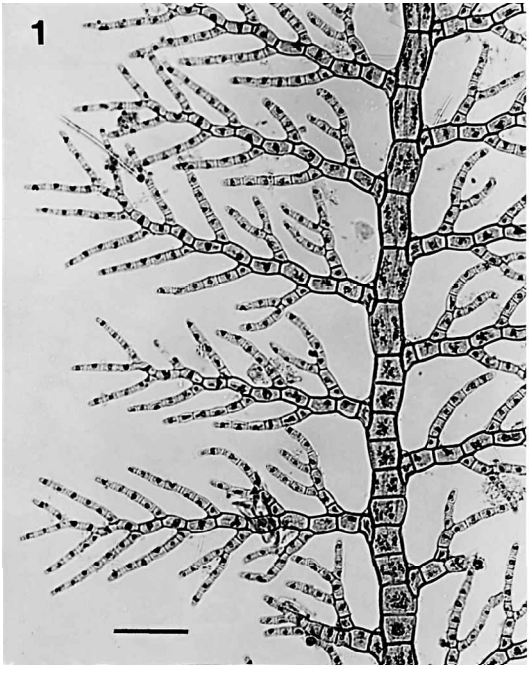



Fig. 1. Branch of *Halopteris filicana* showing alternate pinnate branching. Scale bar = 100 µm.
Fig. 2. Portion of perforate blade of *Anadyomene linkiana*. Scale bar = 500 µm.

**Fucales, Sargassaceae**

*Sargassum polyceratium* Mont.

D.L.B. 4774, Transect BA, 22.ix.1993, 30 m; D.L.B. 4922, Transect BA, 31.viii.1994, 61 m; D.L.B. 5163, Transect BA, 5.v.1995, 46 m; D.L.B. 5195, Transect BA, 4.v.1995, 76 m.

**Chlorophyta: Chlorophyceae, Tetrasporales, Palmellopsidaceae**

*Pseudotetraspora marina* Wille

D.L.B. 5107, Transect BA, 4.v.1995, 61 m; D.L.B. 5143, Transect BA, 5.v.1995, 46 m; D.L.B. 5217, Transect BA, v.1995, 27 m.

*Verdigellas nektongammea* D.L.Ballant. & Aponte

D.L.B. 4846, Transect BA, 1.ix.1994, 76 m; D.L.B. 4907, Transect BA, 31.viii.1994, 61 m; D.L.B. 4946, Transect BA, i.1995, 61 m; D.L.B. 4969, Transect AA, i.1995, 76 m; D.L.B. 4978, Transect AA, i.1995, 91 m; D.L.B. 5180, Transect BA, 4.v.1995, 76 m.

The species is currently known only from its Bahamian type locale at Lee Stocking Island (Ballantine & Aponte 1996).

*Verdigellas peltata* D.L.Ballant. & J.N.Norris

D.L.B. 4328, Transect AA, 16.x.1992, 82 m; D.L.B. 4332, Transect AA, 17.x.1992, 79 m; D.L.B. 4590, Transect AA, 14.iv.1993, 107 m; D.L.B. 4894, Transect BA, 31.viii.1994, 61 m; D.L.B. 4937, Transect BA, i.1995, 61 m; D.L.B. 4970, Transect AA, i.1995, 76 m; D.L.B. 4979, Transect AA, i.1995, 91 m; D.L.B. 5018, Transect BA, 15.x.1994, 120 m; D.L.B. 5055, Transect BA, 5.v.1995, 107 m; D.L.B. 5068, Transect BA, 4.v.1995, 76 m; D.L.B. 5074, Transect BA, 4.v.1995, 61 m; D.L.B. 5126, Transect BA, 5.v.1995, 46 m; D.L.B. 5175, Transect BA, 4.v.1995, 76 m; D.L.B. 5220, Transect BA, 6.v.1995, 122 m.

The species was described on the basis of material collected in Puerto Rico and at Lee Stocking Island (Ballantine & Norris 1994). Hanisak & Blair (1988a) reported this species as ?*Palmophyllum* sp. to a maximum depth of 92 m in Florida and Littler & Littler (2000) indicated a maximum depth of 157 m..

**Ulvales, Gayraliaceae**

*Gayralia oxysperma* (Kütz.) K.L.Vinogr. ex Scagel, P.W.Gabrielson, Garbary, Golden, M.W. Hawkes, S.C.Lindstr., J.C.Oliveira & Widd.
D.L.B. 4862, Transect BA, 1.ix.1994, 76 m

Typically from shallow water, the species is of world-wide distribution (Taylor 1960; Abbott & Hollenberg 1976; Schneider & Searles 1991).

**Ctenocladales, Ulvellaceae**

**Ulvella lens* P.Crouan & H.Crouan

D.L.B. 4786, Transect AA, 22.ix.1993, 85 m.

The species is known from the Caribbean and both coasts of the Atlantic as far north as the Arctic in the west and Scandinavia in the east (Schneider and Searles 1991).

**Cladophorales, Anadyomenaceae**

*Anadyomene linkiana* D.Littler & Littler Fig. 2

D.L.B. 5079, Transect BA, 4.v.1995, 61 m.

Previously only known from its type location at San Salvador Island, Bahamas where Littler & Littler (1991) also collected it from 61 m.

*Anadyomene saldanhae* A.B.Joly & E.C.Oliveira

D.L.B. 4583, Transect AA, 14.iv.1993, 77 m; D.L.B. 4892, Transect BA, 31.viii.1994, 61 m; D.L.B. 4933, Transect BA, i.1995, 61 m; D.L.B. 4990, Transect

AA, i.1995, 46 m; D.L.B. 5063, Transect BA, 5.v.1995, 107 m; D.L.B. 5103, Transect BA, 4.v.1995, 61 m; D.L.B. 5171, Transect BA, 4.v.1995, 76 m.

*Anadyomene saldanhae* was a common member of the deep-water algal turf at Lee Stocking Island. The species is based on Brazilian material originally dredged from 85 m (Joly & Oliveira Filho 1968). In the Bahamas, *A. saldanhae* has previously been reported to a depth of 79 m by Littler & Littler (1991).

*Anadyomene stellata* (Wulfen) C.Agardh

D.L.B. 5139, Transect BA, 5.v.1995, 46 m.

Littler & Littler (1991) reported that small clumps of *A. stellata* have been collected with a submersible to 91.5 m depth.

*Microdictyon boergesenii* Setch.

D.L.B. 4343, Transect AA, 17.x.1992, 31 m; D.L.B. 4585, Transect AA, 14.iv.1993, 77 m; D.L.B. 5076, Transect BA, 4.v.1995, 61 m.

*Microdictyon boergesenii* was a common member of the deep-water algal turf at Lee Stocking Island. Schneider (1976) reported the species to 80 m from North Carolina and Littler & Littler (2000) reported that the species extends to 160 m.

*Microdictyon marinum* (Bory) Silva

D.L.B. 5038, Transect AA, 5.ix.1994, 27 m.

Norris & Olsen (1991) reported the species to 91 m at Green Cay, San Salvador Island, Bahamas.

**Boodleaceae**

*Phyllodictyon pulcherrimum* J.E.Gray

D.L.B. 4954, Transect BA, i.1995, 61 m; D.L.B. 4971, Transect AA, i.1995, 76 m.

*Phyllodictyon pulcherrimum* has been characterized by Kraft & Wynne (1996) as being rare and exclusively from deep water. Humm & Cerame Vivas (1964) reported the species (as *Struvea*) occurring from 60 to 120 m in the Gulf of Mexico and North Carolina.

**Struvea elegans* Børgesen

D.L.B. 4584, Transect AA, 14.iv.1993, 77 m; D.L.B. 5086, Transect BA, 4.v.1995, 61 m; D.L.B. 5147, Transect BA, 5.v.1995, 46 m; D.L.B. 5188, Transect BA, 4.v.1995, 76 m.

*Struvea elegans* is also a deep-water species, known from its type locality, St. Thomas, U.S. Virgin Islands (Børgesen 1912), Puerto Rico (Ballantine & Aponte 1997) and the Dry Tortugas, Gulf of Mexico, Florida (Taylor 1928) in the western Atlantic. It is also known from the Indian Ocean (Kalugina-Gutnik et al. 1992).

**Cladophoraceae**

*Cladophora coelothrix* Kütz.

D.L.B. 5178, Transect BA, 4.v.1995, 76 m.

The species is broadly distributed in the Caribbean and also occurs in Ghana in the eastern Atlantic (van den Hoek 1982). Norris & Olsen (1991) also reported *Cladophora coelothrix* to 76 m at San Salvador Island, Bahamas.

**Cladophora corallicola* Børgesen

D.L.B. 4972, Transect AA, i.1995, 76 m; D.L.B. 4980, Transect AA, i.1995, 91 m.

*Cladophora corallicola* is previously known only from its type locality in St. Johns, U.S. Virgin Islands from 30 m (Børgesen 1913) and also from Brazil (Yoneshigue 1985).

*Cladophora vagabunda* (L.) C.Hoek

D.L.B. 5159, Transect BA, 5.v.1995, 46 m.

*Cladophora vagabunda* is of broad geographic distribution. In the western Atlantic it is found from Newfoundland to Uruguay as well as found in the eastern Atlantic (van den Hoek 1982). Typically a shallow water alga, van den Hoek et al. (1978) reported it to a maximum depth of 40 m in Curaçao, Netherlands Antilles.

**Siphonocladaceae**

**Cladophoropsis macromeres* W.R.Taylor

D.L.B. 4348, Transect AA, 17.x.1992, 31 m; D.L.B. 4758, Transect BA, 26.ix.1993, 29 m.

In the western Atlantic, *Cladophoropsis macromeres* is known from Bermuda, Florida and Jamaica (Taylor 1960), Puerto Rico (Ballantine & Aponte 1997), Venezuela (Schnetter 1978), and Brazil (Joly et al. 1967).

*Cladophoropsis membranacea* (C.Agardh) Børgesen

D.L.B. 5044, Transect AA, 5.ix.1994, 27 m.

Norris & Olsen (1991) reported the species to 85 m at San Salvador Island, Bahamas.

*Dictyosphaeria cavernosa* (Forssk.) Børgesen

D.L.B. 4345, Transect AA, 17.x.1992, 31 m; D.L.B. 5158, Transect BA, 5.v.1995, 46 m.

Taylor (1960) reported that the species occurred to a maximum depth of 55 m depth.

*Ventricaria ventricosa* (J.Agardh) J.L.Olsen & J.A.West

D.L.B. 4999, Transect AA, i.1995, 46 m.

Norris & Olsen (1991) reported the species to 91 m at San Salvador Island, Bahamas.

**Valoniaceae**

*Valonia macrophysa* Kütz.

D.L.B. 4920, Transect BA, 31.viii.1994, 61 m; D.L.B. 5007, Transect AA, i.1995, 46 m; D.L.B. 5064, Transect BA, 5.v.1995, 107 m; D.L.B. 5120, Transect BA, 5.v.1995, 46 m; D.L.B. 5201, Transect BA, 4.v.1995, 76 m.

Norris & Olsen (1991) reported the species to 92 m at San Salvador Island, Bahamas.

**Bryopsidales, Bryopsidaceae**

*Derbesia osterhoutii* (L.R.Blinks & A.C.H.Blinks) Page

D.L.B. 4799, Transect AA, 22.ix.1993, 61 m; D.L.B. 5075a, Transect BA, 4.v.1995, 61 m; D.L.B. 5123, Transect BA, 5.v.1995, 46 m.

Only the *Halicystis* stage was collected.

**Pedobesia simplex* (Meneghini ex Kützing) M.J.Wynne & F.Leliaert

D.L.B. 4908, Transect BA, 31.viii.1994, 61 m; D.L.B. 4958, Transect BA, i.1995, 61 m.

Wynne & Leliaert (2001) placed *Derbesia lamourouxii* (J.Agardh) Solier in synonymy with *Pedobsia simplex* and commented that earlier records from the western Atlantic as *D. lamourouxii* were doubtful. They identified specimens attributed to *D. lamourouxii* as *Bryopsis pennata* J.V.Lamour. var. *secunda* (Harv.) Collins & Herv. and as *D. marina* (Lyngb.) Solier. Thus the Bahamian collections perhaps represent the first authentic report of the species from the western Atlantic. The Bahamian plants were simple without branching, reaching to 2.1 cm in height and to 1.7 mm in diameter. One spherical sporangia, 1.4 mm in diameter, was seen on a single plant. Wynne & Leliaert (2001) reported that *P. simplex* attained a height of 4-5 cm with a diameter to 800 µm and possessed sporangia which measured to 500 µm in diameter. Thus the Bahamian specimens while shorter, have broader filaments with larger diameter sporangia. The size discrepancies reported here may be related to the deep-water habitat from which these specimens were collected. The species is known from the eastern Atlantic, Mediterranean, Japan and Korea (Wynne & Leliaert 2001).

**Ostreobiaceae**

**Ostreobium quekettii* Bornet & Flahault

D.L.B. 4535, Transect BA, 19.ix.1992, 61 m; D.L.B. 4588, Transect AA, 14.iv.1993, 93 m; D.L.B. 4791, Transect AA, 22.ix.1993, 85 m; D.L.B. 4859, Transect BA,

1.ix.1994, 76 m; D.L.B. 4949, Transect BA, i.1995, 61 m; D.L.B. 4975, Transect AA, i.1995, 76 m; D.L.B. 4984, Transect AA, i.1995, 91 m; D.L.B. 5022, Transect BA, 15.ix.1994, 120 m; D.L.B. 5179, Transect BA, 4.v.1995, 76 m.

*Ostreobium quekettii* is known from the Caribbean Sea to the Arctic (Humm 1979) as well as in the eastern Atlantic, and the Pacific west coast of North America (Schneider & Searles 1991). The species is a common endophyte in shells in shallow to intertidal environments (Humm 1979) and at Lee Stocking Island was the deepest occurring alga. Although not collected at those depths, *O. quekettii* was visually observed from the submersible to greater than 200 m in depth (Aponte & Ballantine 2001).

## Caulerpaceae

*Caulerpa microphysa* (Weber Bosse) Feldmann

D.L.B. 4778, Transect BA, 22.ix.1993, 30 m

The species has been reported to 61-70 m at San Salvador Island, Bahamas by Norris & Olsen (1991) and to 110 m by Taylor (1960).

## Udoteaceae

**Avrainvillea cyathiformis* sp. nov. Figs. 3, 4

Plantae olivaceae, usque ad 4.0 cm altae; multi stipites usque ad 12 mm longi et 1.6-2.6 mm diametro, e massibus basalibus rhoizoideisque exorientes; laminae zonatae aut flabelliformes aut infundibuliformes, usque ad 3.0 mm altae et 3.5 cm latae ubi flabelliformes et 3.5 cm latae ubi infundibuliformes; laminae plerumque anastomosantes cum aliis laminis ex eodem hapterono; laminae tenues, usque ad 1.0 mm crassae maxime; filamenta medullosa intimaque cylindrica, usque ad 19 µm diametro, decrescentia 6.0-8.0 µm diametro, tortuosa prope superficiem; apices siphonacei obtusique.

Holotype: D.L. Ballantine 4917, Lee Stocking Island (Exuma Chain), Bahamas, Transect BA: 23°4678‘N and 76°0500‘W, 61 m, 31.viii.1994 (Alg. Coll. # US-204257).

Algae are olive green in color and measure to 4.0 cm in height. Multiple stipes, to 12 mm in length and from 1.6 to 2.6 mm in diameter, arise from basal rhizoidal masses. The blades are zonate and either fan- or funnel- shaped (Fig. 3), measuring 3.0 cm high and to 3.5 cm broad when fan-shaped, and to 3.5 mm across when funnel-shaped. Blades commonly anastomose with other blades from the same holdfast. Blades are thin, measuring only to a maximum of 1.0 mm in thickness, becoming almost monosiphonous at the blade margin. Innermost medullary filaments are cylindrical, measuring to 19 µm in diameter (Fig. 4). Medullary filaments are constricted immediately distal to the wide-angled dichotomies. The larger medullary filaments are occasionally briefly moniliform for short distances. Filaments of the blade decrease in diameter, 6.0-8.0 µm, and becoming tortuous towards the surface (Fig. 4). Siphon apices are obtuse.



Figs. 3, 4. *Avrainvillea cyathiformis* sp. nov. – Fig. 3. Habit of the holotype. Scale bar = 10 mm. – Fig. 4. Nearly cylindrical inner medullary filament (arrowheads) becoming briefly moniliform above the dichotomy and smaller diameter outer filaments (arrows) becoming tortuous distally. Note constrictions (double arrowhead) above branching dichotomies of medullary filament. Scale bar = 50 μm.

The new species is unique among *Avrainvillea* species in having a cyathiform blade. Following Littler & Littler's (1992) key to *Avrainvillea* species, the new species would appear to be most similar to *A. levis* M.Howe f. *transluscens* D.Littler & Littler. Aside from its cyathiform blade, the new species differs from the latter entity in not possessing a cordate base, not attaining the height (to 15 cm) and the larger dimensions of the cortical siphons (to 30 μm in diameter) as seen in *A. levis* f. *transluscens*.

*Avrainvillea longicaulis* (Kütz.) G.Murray & Boodle

D.L.B. 4344, Transect AA, 17.x.1992, 31 m; D.L.B. 4757, Transect BA, 26.ix.1993, 29 m.

Norris & Olsen (1991) reported the species to a depth of 61 m at San Salvador Island, Bahamas.

*Halimeda copiosa* Goreau & E.A.Graham

D.L.B. 4575, Transect AA, 14.iv.1993, 77 m; D.L.B. 4765, Transect BA, 26.ix.1993, 29 m; D.L.B. 4873, Transect BA, 1.ix.1994, 76 m; D.L.B. 4926, Transect BA, 31.viii.1994, 61 m; D.L.B. 4966, Transect BA, i.1995, 61 m; D.L.B. 5066, Transect BA, 5.v.1995, 107 m; D.L.B. 5115, Transect BA, 4.v.1995, 61 m; D.L.B. 5169, Transect BA, 5.v.1995, 46 m.

Blair & Norris (1988) reported the species to a maximum of 91 m depth at San Salvador Island, Bahamas while Littler & Littler (2000) indicated a maximum depth of 100 m.

*Halimeda cryptica* Colinv. & E.A.Graham

D.L.B. 4928, Transect BA, 31.viii.1994, 61 m; D.L.B. 4967, Transect BA, i.1995, 61 m; D.L.B. 5117, Transect BA, 4.v.1995, 61 m; D.L.B. 5136, Transect BA, 5.v.1995, 46 m.

Littler & Littler (2000) reported a maximum depth of 174 m for the species.

*Halimeda discoidea* Decne.

D.L.B. 4759, Transect BA, 26.ix.1993, 29 m; D.L.B. 4773, Transect BA, 22.ix.1993, 30 m; D.L.B. 4797, Transect AA, 22.ix.1993, 61 m; D.L.B. 4925, Transect BA, 31.viii.1994, 61 m; D.L.B. 5114, Transect BA, 4.v.1995, 61 m; D.L.B. 5165, Transect BA, 5.v.1995, 46 m.

Littler & Littler (2000) reported a maximum depth of 80 m for the species.

*Halimeda incrassata* (J.Ellis) J.V.Lamour.

D.L.B. 4763, Transect BA, 26.ix.1993, 29 m; D.L.B. 5040, Transect AA, 5.ix.1994, 27 m; D.L.B. 5116, Transect BA, 4.v.1995, 61 m; D.L.B. 5167, Transect BA, 5.v.1995, 46 m.

*Halimeda lacrimosa* M.Howe

D.L.B. 4339, Transect AA, 17.x.1992, 31 m; D.L.B. 4749, Transect BA, 26.ix.1993, 29 m; D.L.B. 4771, Transect BA, 22.ix.1993, 30 m; D.L.B. 4914, Transect BA, 31.viii.1994, 61 m.

Blair & Norris (1988) also reported the species to a maximum of 61 m at San Salvador Island, Bahamas.

*Halimeda simulans* M.Howe

D.L.B. 4357, Transect AA, 17.x.1992, 31 m; D.L.B. 4760, Transect BA, 26.ix.1993, 29 m; D.L.B. 4784, Transect BA, 22.ix.1993, 30 m.

*Halimeda tuna* (Ellis & Sol.) J.V.Lamour.

D.L.B. 4355, Transect AA, 17.x.1992, 31 m; D.L.B. 4953, Transect BA, i.1995, 61 m; D.L.B. 5004, Transect AA, i.1995, 46 m; D.L.B. 5037, Transect AA, 5.ix.1994, 27 m.

Blair & Norris (1988) report the species to a maximum of 73 m at San Salvador Island, Bahamas.

*Penicillus dumetosus* (J.V.Lamour.) Blainv.

D.L.B. 4342, Transect AA, 17.x.1992, 31 m; D.L.B. 4761, Transect BA, 22.ix.1993, 29 m.

Hanisak & Blair (1988a) reported this species from 28 m in Florida.

*Pseudocodium floridanum* Dawes & A.C.Mathieson

D.L.B. 4906, Transect BA, 31.viii.1994, 61 m; D.L.B. 4948, Transect BA, i.1995, 61 m; D.L.B. 5078, Transect BA, 4.v.1995, 61 m; D.L.B. 5210, Transect BA, v.1995, 27 m.

Norris & Olsen (1991) also collected the alga at a maximum depth of 61 m at San Salvador Island, Bahamas.

**Rhipiliopsis stri* (S.Earle & J.R.Young) Farghaly & Denizot

D.L.B. 4864, Transect BA, 1.ix.1994, 76 m; D.L.B. 4927, Transect BA, 31.viii.1994, 61 m; D.L.B. 4938, Transect BA, i.1995, 61 m; D.L.B. 4991, Transect AA, i.1995, 46 m.

The species was originally described as a species of *Siphonoclathrus* based on collections in Panama at 5-10 m by Earle & Young (1972). *Siphonoclathrus* was transferred to *Rhipiliopsis* by Farghaly & Denizot (1979). In the tropical western Atlantic, the species is also known from Curaçao, Netherlands Antilles to 60 m (van den Hoek 1978) as *Udotea reticulata* C.Hoek, and to 20 m in Puerto Rico (Ballantine & Wynne 1986).

*Rhipocephalus phoenix* (J.Ellis & Sol.) Kütz.

D.L.B. 4340, Transect AA, 17.x.1992, 31 m; D.L.B. 4750, Transect BA, 26.ix.1993, 29 m; D.L.B. 4772, Transect BA, 22.ix.1993, 30 m; D.L.B. 4883, Transect AA, 31.viii.1994, 32 m.

*Rhipocephalus oblongus* (Decne.) Kütz.

D.L.B. 5039, Transect AA, 5.ix.1994, 27 m.

Littler & Littler (2000) reported a maximum depth of 40 m for the species.

*Udotea dixonii* D.Littler & Littler

D.L.B. 5035, Transect AA, 5.ix.1994, 27 m.

Littler & Littler (1990, 2000) characterized this species as typically being from deep-water habitats (17-54 m).

*Udotea flabellum* (J.Ellis & Sol.) J.V.Lamour.

D.L.B. 4353, Transect AA, 17.x.1992, 31 m; D.L.B. 4764, Transect BA, 26.ix.1993, 29 m.

*Udotea looensis* D.Littler & Littler

D.L.B. 4346, Transect AA, 17.x.1992, 31 m; D.L.B. 4762, Transect BA, 26.ix.1993, 29 m.

*Udotea looensis* is generally collected at 10-20 m (Littler & Littler 1990).

*Udotea unistrata* D.Littler & Littler

D.L.B. 5002, Transect AA, i.1995, 46 m.

Typically a deep water alga, Littler & Littler (1990) reported the species as occurring in 24-46 m.

**Acknowledgements**

This study was partially funded by the Caribbean Marine Research Center of the National Oceanographic and Atmospheric Administration-National Undersea Research Program which made ship time available aboard the *R/V Bahama Hunter* and dives using the research submersible *DSV Nekton Gamma*. We wish to express our appreciation to the submersible and tender crew, particularly Mr. Robert Wicklund Jr., Ray Brockway and Don and Sally Tondro, as well as to the administrative staff of Lee Stocking Island. Michael J. Wynne provided helpful comments on *Halopteris filicina* and *Pedobesia simplex*. We further appreciate the constructive comments provided in review by Craig Schneider. Ms. Angela Piper provided translation of the Latin description.

**References**

ABBOTT, I.A. & G.J. HOLLENBERG (1976): Marine Algae of California. - Stanford University Press, Stanford, California. 827 pp.

APONTE, N.E. & D.L. BALLANTINE (2001): Algal species distribution and composition as a factor of depth on the deep insular reef slope at Lee Stocking Island, Bahamas. - Deep Sea Res. Part I, **48:** 2185-2194.

BALLANTINE, D.L. & N.E. APONTE (1996): *Verdigellas nektongammea* (Tetrasporales, Chlorophyta), a new deep-water species from the Bahamas. - Nova Hedwigia **62:** 425-429.

BALLANTINE, D.L. & N.E. APONTE (1997): A revised checklist of the benthic marine algae known to Puerto Rico. - Carib. J. Sci. **33:** 150-179.

BALLANTINE, D.L. & J.N. NORRIS (1994): *Verdigellas*, a new palmelloid genus (Tetrasporales, Chlorophyta) from the tropical west Atlantic. - Cryptogamic Bot. **4:** 368-372.

BALLANTINE, D. L. & M. J. WYNNE (1986): Notes on the marine algae of Puerto Rico I. Additions to the Flora. - Bot. Mar. **29:** 131-135.

BLAIR, S.M. & J.N. NORRIS (1988): The deep-water species of *Halimeda* Lamouroux (Halimedaceae, Chlorophyta) from San Salvador Island, Bahamas: species composition, distribution and depth records. - Coral Reefs **6:** 227-236.

BØRGESEN, F. (1912): Some Chlorophyceae from the Danish West Indies. - Bot. Tidsskr. **32:** 241-274.

BØRGESEN, F. (1913): The marine algae of the Danish West Indies. I. Chlorophyceae. - Dansk. Bot. Arkiv **1:** 1-160.

BRUMMITT, R.K. & C.E. POWELL (eds) (1992): Authors of Plant Names. - Kew, Royal Botanic Gardens. U.K. 732 pp.

BUCHER, K.E & J.N. NORRIS (1992): A new deep-water red alga, *Titanophora submarina* sp. nov. (Gymnophloeaceae, Gigartinales), from the Caribbean Sea. - Phycologia **31:** 180-191.

EARLE, S.A & J.R. YOUNG (1972): *Siphonoclathrus* a new genus of Chlorophyta (Siphonales: Codiaceae) from Panama. - Occ. Pap. Farlow Herb. Cryptogamic Bot. **1:** 1-4

EISEMAN, N.J. & S.M. BLAIR (1982): New records and range extensions of deepwater algae from East Flower Garden Bank, northwestern Gulf of Mexico. - Contr. Mar. Sci. **25:** 21-26.

EISEMAN, N.J. & S.A. EARLE (1983): *Johnson-sea-linkia profunda*, a new genus and species of deep-water Chlorophyta from the Bahama Islands. - Phycologia **22:** 1-6.

EISEMAN, N.J. & R.L. MOE (1981): *Maripelta atlantica* sp. nov. (Rhodophyta, Rhodymeniales) a new deep-water alga from Florida. - J. Phycol. **17:** 299-308.

EISEMAN, N.J. & J.N. NORRIS (1981): *Dudresnaya patula sp. nov.*, an unusual deep water red alga from Florida. - J. Phycol. **17:** 186-191.

FARGHALY, M.S. & M. DENIZOT (1979): Le genre *Rhipiliopsis*. Definition et place dans les Caulerpales (Chlorophycees). Rev. Algol. N.S. **14:** 169-184.

HANISAK, M.D. & S.M. BLAIR (1988a): The deep-water macroalgal community on the east Florida continental shelf. - Helgoländer Meeresunters. **42:** 133-163.

HANISAK, M.D. & S.M. BLAIR (1988b): Deep-water macroalgal communities with emphasis on Florida and the Bahamas. – In: AGEGIAN, C.R. (ed.): Biogeochemical Cycling and Fluxes Between the Deep Euphotic Zone and Other Oceanic Realms: 61-83. National Undersea Research Program, Research Report 88-1.

HANISAK, M.D., LITTLER, M.M., LITTLER, D.S. & J.A. KILAR (1987): Discovery of a deep-water population of *Sargassum hystrix* off San Salvador Island, Bahamas. - J. Phycol. **23** Suppl.: 20.

HOEK, C. VAN DEN (1978): Marine algae from the coral reef of Curaçao, Netherlands Antilles. I. Three new and one rarely observed species from the steep fore-reef slope. - Aquatic Bot. **5:** 47-61.

HOEK, C. VAN DEN (1982): A taxonomic revision of the American species of *Cladophora* (Chlorophyceae) in the North Atlantic Ocean and their geographic distribution. - North Holland Publishing Co., Amsterdam. 236 pp.

HOEK, C. VAN DEN, C. BREEMAN, R.P.M. BAK & G. VAN BUURT (1978): The distribution of algae, corals and gorgonians in relation to depth, light attenuation, water movement and grazing pressure in the fringing coral reef of Curaçao, Netherlands Antilles. - Aquatic Bot. **5:** 1-46.

HUMM, H.J. (1979): The Marine Algae of Virginia. - The University Press of Virginia, Charlottesville. 263 pp.

HUMM, H.J. & M.J. CERAME VIVAS (1964): *Struvea pulcherrima* in North Carolina. - J. Elisha Mitchell Soc. **80:** 23-24.

JOLY, A.B. & E.C. OLIVEIRA FILHO (1968): Notes on Brazilian algae II. A new *Anadyomene* of the deep water flora. - Phykos **7:** 27-31.

JOLY, A.B., Y. UGADIM, E.C. OLIVEIRA FILHO & M. CORDEIRO MARINO (1967): Additions to the marine flora of Brazil. VI. - Bol. Fac. Filos., Ciênc. & Letras Univ. São Paulo (Ser. Bot. 22) **305:** 171-194.

KALUGINA-GUTNIK, A.A., L.P. PERESTENKO & T.V. TITLYANOVA (1992): Species composition, distribution and abundance of algae and seagrasses of the Seychelles Islands. In: LITTLER, M.M. & D.S. LITTLER (eds): Results of the USSR-USA Expedition in Marine Biology to the Seychelles Island - Atoll Res. Bull. **369:** 67 pp.

KRAFT, G.T. & M.J. WYNNE (1996): Delineation of the genera *Struvea* Sonder and *Phyllodictyon* J.E. Gray (Cladophorales, Chlorophyta). - Phycol. Res. **44:** 129-142.

LAWSON, G.W. & D.M. JOHN (1982): The marine algae and coastal environment of tropical West Africa. - Beih. Nova Hedwigia **70:** 1-455

LITTLER, D.S. & M.M. LITTLER (1990): Systematics of *Udotea* species (Bryopsidales, Chlorophyta) in the tropical western Atlantic. - Phycologia **29:** 206-252.

LITTLER, D.S. & M.M. LITTLER (1991): Systematics of *Anadyomene* species (Anadyomenaceae, Chlorophyta) in the tropical western Atlantic. - J. Phycol. **27:** 101-108.

LITTLER, D.S. and M.M. LITTLER (1992): Systematics of *Avrainvillea* (Bryopsidales, Chlorophyta) in the tropical western Atlantic. - Phycologia **31:** 375-418.

LITTLER, M.M., LITTLER, D.S., BLAIR, S.M. & J.N. NORRIS (1985): Deepest known plant life discovered on an uncharted seamount. - Science **227:** 57-59.

LITTLER, D.S. and M.M. LITTLER (2000): Caribbean Reef Plants: An Identification Guide to the Reef Plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. - Offshore Graphics, Inc., Washington, D.C. 542 pp.

MACINTYRE, I.G., K. RUTZLER, J.N. NORRIS, K.P. SMITH, S.D. CAIRNS, K.E. BUCHER & R.S. STENECK (1991): An early Holocene reef in the western Atlantic: submersible investigations of a deep relict reef off the west coast of Barbados, W.I. - Coral Reefs **10:** 167-174.

NORRIS, J.N. & J.L. OLSEN (1991): Deep-water green algae from the Bahamas, including *Cladophora vandenhoekii* sp. nov. (Cladophorales). - Phycologia **30:** 315-328.

SCHNEIDER, C.W. (1976): Spatial and temporal distributions of benthic marine algae on the continental self of the Carolinas. - Bull. Mar. Sci. Gulf Caribbean **26:** 133-151.

SCHNEIDER, C.W. & R.B. SEARLES (1991): Seaweeds of the Southeastern United States. Cape Hatteras to Cape Canaveral. - Duke University Press, Durham. 553 pp.

SCHNETTER, R. (1978): Marine Algen der karibischen Küsten von Kolumbien. II. Chlorophyceae. - Bibliotheca Phycologica **42:** 199 pp.

TAYLOR, W. R. (1928): The marine algae of Florida with special reference to the Dry Tortugas. - Papers from the Tortugas Laboratory of the Carnegie Institution of Washington **25:** 3-219.

TAYLOR, W. R. (1955): Notes on algae from the tropical Atlantic Ocean. IV. - Papers of the Michigan Academy of Science, Arts, and Letters **40:** 67-76.

TAYLOR, W. R. (1960): Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas. - University Michigan Press, Ann Arbor, 870 pp.

WYNNE, M.J. & F. LELIAERT (2001): *Pedobesia simplex* (Kützing) comb. nov. (Chlorophyta), a new name for *P. lamourouxii* and its first report from the Indian Ocean. - Cryptogamie, Algol. **22:** 3-14.

WYNNE, M.J. & C.W. SCHNEIDER (1996): *Frikkiella* gen. nov. (Delesseriaceae, Rhodophyta) from Bermuda and the Caribbean Sea. - Syst. Bot. **21:** 77-84.

YONESHIGUE, Y. (1985): Taxonomie et écologie des algues marines dans la région de Cabo Frio (Rio de Janeiro, Brésil). - Thèse Présentée à l'Université d'Aix-Marseill II, Faculté des Sciences de Luminy pour obtener le grade de Docteur d'Etat-Sciences. 466 pp.

Received 23 November 2001, accepted in revised form 28 June 2002.