The marine algal (seaweed) flora of the Azores: 4, further additions

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Eight records of seaweeds are reported new to the mid-Atlantic Azores archipelago. *Coelothrix irregularis* and *Lejolisia* sp. fall within their overall distributional range. *Sebdenia rodrigueziana* and *Syringoderma floridana* have their north-western limit of distribution there. The islands represent the western limit of occurrence for *Antithamnionella boergesenii*, *Aphanocladia stichidiosa*, *Sebdenia dichotoma*, and *Codium effusum.* The present and previous papers in this series reveal the extension in range distribution to the west of many of the new records found in the Azores, raising the question as to why the western Atlantic acts as a barrier to dispersal. The new records presented here increase the current total of species recorded on the Azores to 385 (55 Chlorophyta, 74 Heterokontophyta (Phaeophyceae), and 256 Rhodophyta), showing that this isolated island group supports a relatively rich benthic marine algal flora.

Key words: Atlantic, benthic marine macroalgae, biogeography, morphology, taxonomy

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INTRODUCTION

The Azores archipelago, lying isolated in the mid-Atlantic, nearly 1200 km from Europe, is composed of nine islands, the Formigas islets and nearby sublittoral banks and sea-mounts. These rocky islands, of relatively recent volcanic origin, are spread over a distance of 500 km from east to west. With a warm temperate climate, the Azores have a moderately rich benthic marine algal flora with 370 species (Tittley et al. 2009). Since then, taxonomic revision of herbarium material and intensive fieldwork at locations not previously studied continues to add new records to the flora which now totals 377 (Rosas-Alquicira et al. 2009; Athanasiadis & Neto 2010; Parente et al. 2010; Couto et al. 2011; León-Cisneros et al. 2011). In the present paper, further species are added as new to the Azorean marine algal flora.

MATERIAL AND METHODS

The algae considered in this paper were collected during field studies at eulittoral and sublittoral levels down to 30 m on several of the islands of the archipelago. Fieldwork was undertaken throughout the year. Material collected was either fixed in 5% formalin seawater or was pressed and dried. When necessary microscope slides were made by staining with 1% aqueous aniline blue, fixed with 1% HCl and permanently mounted

using Karo® corn syrup (Best Foods, Englewood Cliffs, NJ, USA). Dried specimens from earlier collections were re-hydrated and prepared for microscopic examination as above. All specimens were given an individual registration number and deposited in the herbarium of the University of the Azores (AZB). Nomenclatural and taxonomic status and distributional information used here follow *AlgaeBase* (Guiry & Guiry [cited 2011]).

RESULTS

Systematic account, new species records

CHLOROPHYTA

Bryopsidophyceae, Bryopsidales, Codiaceae:
Codium effusum (Rafinesque) Delle Chaije

Described and illustrated in Ardré (1970, pp. 505-506); Afonso-Carrillo & Sansón (1999, pp. 136); Cabioc'h et al. (2006, pp. 194, figure 168) and Braune (2008, pp. 84, figure 19.4).

A green pulvinate, felty mat that grows closely adherent to the substratum. The thallus has a lax and spongy consistency, and comprises a pseudoparenchyma of siphonous filaments, the utricles of which are easily squashed apart. The utricles have a flat apex with rounded corners and are 800-1200 µm long and 50-120 µm wide. Hairs are situated 80 µm behind the apex of the utricle; as many as 12 hair scars were observed in the Azores material. *Codium effusum* is distinguished from *C. adhaerens* C. Agardh by its larger utricles (more than 1 mm long), and from *C. coralloides* (Kützing) P.C. Silva, which is more mamillate, cerebelliform, and less firmly attached to the substratum.

The species grows on rocks, in pools and crevices, at eulittoral and sublittoral levels to 5 m depth and was found commonly in summer.

Codium effusum occurs widely in the Mediterranean Sea, in the North Atlantic in mainland Portugal and the Madeira and Canary archipelagos, as well as in the Indian and Pacific Oceans (Guiry & Guiry [cited 2011]). In the North Atlantic Ocean, Portugal represents its most northern occurrence, while the Azores are at its western limit of occurrence.

Specimens examined: Pico: Lajes de Pico, 03-07-2007, PIX-07-77 (AZB), PIX-07-111 (AZB); 16-07-2007, PIX-07-785 (AZB); Baía de Canas, 31-07-2007, PIX-07-1403 (AZB).

HETEROKONTOPHYTA

Phaeophyceae, Syringodermatales, Syringodermataceae:
Syringoderma floridana E.C. Henry

Described and illustrated in Henry (1984, pp. 419-426, figure 4) and Haroun et al. (1993, pp. 131-132, figure 4).

Small flabellate thalli that grow to 20 mm tall and comprise a monostromatic blade which narrows to a short stipe attached to the substratum by a mat of rhizoids; the blade is often divided into wedge-shaped segments and may bear a darkened apical fringe. Fertile material has not been found in the Azores.

Thalli are slightly larger than those found in the Canary Islands (15 mm) but are within the size range of original collections from Florida (10-25 mm; Henry 1984; Dawes & Mathieson 2008).

The species grew in sandy, rocky habitat at 24 m depth and was found only once in summer. The occurrence of *S. floridana* at this depth contrasts with its original discovery in Florida and subsequently in the Canary islands at much greater depths (to 90 m, Henry 1984; Haroun et al. 1993).

The species is known from the warm temperate and tropical regions of the Atlantic Ocean; the Azores record represents its northern limit of distribution.

Specimens examined: Pico**:** São Caetano, 26-07-2007, PIX-07-1279A-B (AZB).

RHODOPHYTA

Florideophycideae, Sebdeniales, Sebdeniaceae:
Sebdenia dichotoma Berthold

Described and illustrated in Codomier (1973, pp. 98-102, figures 1-3), Díaz-Villa et al. 2004, pp. 167-176) and Berecibar et al. (2009, pp. 223, figures 19-20).

Thalli are red to brownish yellow fronds, cartilaginous and with smooth margins, erect, to 210 mm high, terete to compressed and irregularly dichotomously branched, attached to the substratum by a single basal holdfast. Dichotomous segments are 1-2mm long, branched at angles of 45–90º. The thallus is 553-1293 µm thick and comprises a three-layered cortex and a lax medulla. The outer cortex has one layer of densely

pigmented, rounded (3-8 µm in diameter) to elliptic (6x14 µm) cells. A subcortex comprises two layers of cells, the outer 4-16 µm in diameter, the inner 18-70 µm in diameter. The medulla is formed of filaments 10-20 µm in diameter, and stellate cells 24-92 µm in diameter. Gland-like cells are absent. Cruciate tetrasporangia (26 µm diameter) were observed on a single specimen collected in August.

This species was found occasionally in spring and summer 5 to 18 m deep in sandy, rocky places.

Sebdenia dichotoma is widely distributed in the Mediterranean Sea (Balearic islands, Corsica, Spain, Italy and Egypt) but is uncommon in the Atlantic Ocean, being reported only for the Canary islands (Díaz-Villa et al. 2004) and mainland Portugal (Berecibar et al. 2009). The Azores record lies close to its northern limit of occurrence in the Atlantic Ocean and is its western limit.

Specimens examined: São Miguel: São Vicente, 29-07-1993, SMG-93-131A (AZB); 23-09-1993, SMG-93-28; 16-08-1994, SMG-94-249 (AZB); São Vicente, 16-07-1994, SMG-94-178 A-C (AZB); São Roque, 27-04-1995, SMG-95-16 (AZB); Lagoa (Piscinas), 25-07-1996, SMG-96-372 A-E (AZB); Mosteiros, 12-03-2007, SMG-07-02 (AZB). Pico: Madalena, 24-07-2007, PIX-07-1200 (AZB).

Sebdenia rodrigueziana (Feldmann) Codomier ex Athanasiadis

Described and illustrated in Haroun et al. (2003, pp. 128, figure 129) and Berecibar et al. (2009, pp. 223-224, figures 21-23).

Thallus of red-pinkish to violet fronds, soft, erect, 130 mm high, more or less cartilaginous and mucilaginous, cuneate and flattened, 384-622 µm thick, with proximally smooth margins and attached to the substratum by a basal holdfast. The cortex comprises a single layer of isodiametric cells 3-8 µm in diameter and is densely pigmented. The subcortex has an outer layer of elliptical cells 8-18 µm in diameter, and an inner hyaline layer of polyhedral cells, 22-53 µm in diameter. The medulla is lax and composed of stellate cells, 31-65 µm in diameter, cylindrical filaments 9-20 µm in diameter and gland-like cells. The latter are pedicellate, 16-36 µm in diameter and occur centrally in the medulla. Smaller and sessile gland-like cells, 6-24 µm in diameter, have been observed on the medullary filaments. Fertile material was not observed.

The specimens described above are in agreement with that given by Berecibar et al. (2009) but whose illustrations show a thallus with a cordate, not cuneate, habit and which also lacks the typical sub-dichotomous tips.

Occasionally found in spring and summer at low intertidal and sublittoral levels from 5 to 27 m deep in sandy, rocky places.

This species is distributed in the Mediterranean Sea (Balearic islands, Corsica, Spain, Italy and Greece). In the Atlantic Ocean it is known only from the southern Macaronesian archipelagos (Canary and Cape Verde; Guiry & Guiry [cited 2011]). The Azores are at the northern and western limits of occurrence in the Atlantic Ocean.

Specimens examined: São Miguel: Caloura, 03-05-1993, SMG-93-154 A-B (AZB); São Roque, 22-08-1995, SMG-95-209; 11-07-1996, SMG-96-121A-B (AZB); Moaçor, 12-07-1996, SMG-96-147 (AZB); São Vicente, 15-07-1996, SMG-96-186 A-I (AZB); 16-07-1996, SMG-96-219 B (AZB); 18-07-1996, SMG-96-270 (AZB); 23-07-1996, SMG-96-340 A-H; 12-07-1997, SMG-97-55 (AZB); 16-07-1997, SMG-97-147 (AZB); Maia, 21-07-1997, SMG-97-271 (AZB); Ribeirinha, 29-06-1999, SMG-99-857 A-C (AZB). Pico: Calheta do Nesquim, 12-07-2007, PIX-07-676 (AZB), PIX-07-676 (AZB); Cachorro, 20-07-2007, PIX-07-1064 (AZB); São Caetano, 26-07-2007, PIX-07-1288 (AZB); Manhenha, Piedade, 27-07-2007, PIX-07-1318 (AZB), PIX-07-1324 (AZB).

Rhodymeniales, Champiaceae:

Coelothrix irregularis (Harvey) Børgesen

Described and illustrated in Taylor (1967, pp. 488, plate 45, figure 3, plate 46, figure 4) and Afonso-Carrillo et al. (1992, pp. 284-285, figures 3-4)

Terete thalli that grow to 20 mm high, bushy or in cushions, loosely to densely entangled; the terete branches are somewhat tapering, frequently inter-adherent and fusing, 190-500 µm in diameter and partially hollow. The medulla comprises longitudinal filaments and 4-5 layers of large cells. Longitudinal filaments, to 12 µm in diameter, run along the inner surface and bear inwardly-

directed ovoid-clavate mucilaginous gland cells, 12-15 µm x 25 µm long, that project into the cavity. Medullary cells (15-25 x 10-25 µm) are covered by a single layer of small cortical cells (10 x 50µm). Fertile material was not observed.

The studied material agrees with the description in Taylor (1967) although the medullary and cortical cells are slightly smaller.

Coelothrix irregularis grew on open rocks, in the low intertidal and sublittoral at 20-22 m depth. It is an uncommon species that was found at two locations on Pico and in São Miguel in summer.

This species is widely distributed in the Caribbean, Indian, Pacific and Atlantic Oceans, including the Canary and Salvage islands (Guiry & Guiry [cited 2011]).

Specimens examined: Pico: Manhenha, Piedade, 04-07-2007, PIX-07-184A, HIS-07-85 (AZB). São Miguel: Maia, 02-06-2004, SMG-04-154 (AZB).

Ceramiales, Ceramiaceae:

Antithamnionella boergesenii (Cormaci & G. Furnari) Athanasiadis

Described and illustrated in Athanasiadis (1996, pp. 104-105, figure 45 A-E).

Thalli to 1 mm tall are formed of rose red, ecorticate, monosiphonous filaments with prostrate axes that bear erect branches. Branched to three to four orders with whorls of four branches on each axial cell (Fig. 1.1). The axial cells decrease in size towards the apex, measuring 150 x 35 µm at the base, 70 x 25 µm in the middle region and 10 x 10 µm near the apex. Whorl-branches measured 150 µm long, with cells decreasing in size towards the apex; the basal cell was generally smaller than the suprabasal cell (30 x 25 µm). Lens-shaped gland cells are cut off laterally; fully developed gland cells lie on the mother cell touching the next cell often at the origin of a branch; two gland cells may develop in sequence (Fig. 1.2). Fertile material was not observed.

Antithamnionella boergesenii grew on a turf of *Corallina elongata* J. Ellis *et* Solander and *Jania* spp. over rocks, also in pools and crevices at lower eulittoral levels. An uncommon species found only at two locations in summer.

This species is known from the western-Mediterranean Sea (France, Italy), the Atlantic Ocean (Spain, Mauritania) and the Canary, Cape Verde, Madeira and Salvage islands (Guiry & Guiry [cited 2011]). The Azores are at the western limit of occurrence.

Specimens examined: Pico: Santo Amaro (Caisinho), 19-07-2007, PIX-07-968A (AZB); Guindaste, 1-08-2007, PIX-07-1486 (AZB).

Rhodomelaceae:

Aphanocladia stichidiosa (Funk) Ardré

Described and illustrated in Rojas-González & Afonso-Carrillo (2003, pp. 75-82, figures 1-7).

Dark-brown, tufted, filamentous thalli grow to 9 mm in length and comprise prostrate (to 170 µm in diameter) and erect axes (Fig. 1.3). The thallus is polysiphonous in structure, comprising an axial cell surrounded by 4 periaxial cells. On the erect system, the main axis is 110 µm wide at the base and 40 µm wide at the apex, and bears many short cylindrical branchlets, helicoidally arranged. Filaments are corticated with small cortical cells between the periaxial cells and are attached to the substratum by unicellular rhizoids developed from the distal portion of the periaxial cells. Cells of the prostrate axes are larger than those of the erect system and measure 120 µm in length and 70 µm in width. Basal cells of the erect system are 40 µm in length by 30 µm wide and decrease in size progressively to 25 µm in length by 15 µm wide near the apices. Tetrasporangia (Fig. 1.3) measured 15-17(-22) µm in diameter but were found on only one specimen (PIX-07-1333, AZB). They were smaller than those described by Rojas-González & Afonso-Carrillo (2003).

Aphanocladia stichidiosa grew on *Corallina elongata* at low eulittoral level and on *Sargassum spp*, *Dictyota spp* and *Corallina elongata* in the sublittoral to 30 m depth in sandy, rocky places. It was common in summer.

This species occurs in the Mediterranean Sea and the Atlantic Ocean from Spain to Morocco and the Canary islands (Guiry & Guiry [cited 2011]). The Azores are at the western limit of occurrence.

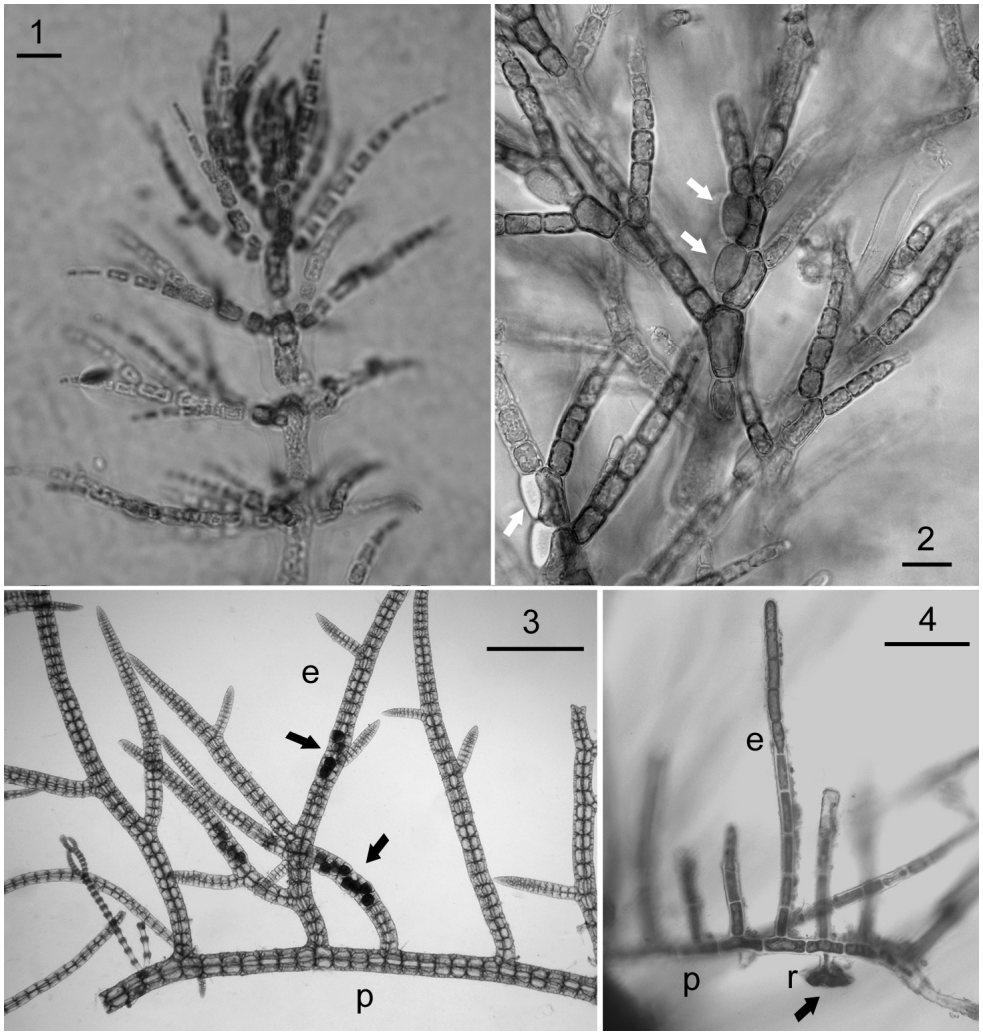

Fig. 1. 1.1) *Antithamnionella boergesenii*, habit showing branching and 1.2) lateral gland cells (scale bars= 20 µm); 1.3 *Aphanocladia stichidiosa*, habit showing prostrate (p) and erect (e) axes bearing tetrasporangia (arrows; scale bar= 0.5 mm); 1.4. *Lejolisia* sp., habit showing prostrate (p) and erect (e) axes, and unicellular rhizoids (r) with digitate pads (arrow; scale bar= 80 µm).

Specimens examined: Pico: Madalena, 24-07-2007, PIX-07-1197 (AZB); São Caetano, 26-07-2007, PIX-07-1301 (AZB); Manhenha, Piedade, 27-07-2007, PIX-07-1333 (AZB), PIX-07-1334 (AZB). Terceira: Cinco Ribeiras, 16-07-2008, TER-08-08 (AZB); Praia da Vitória, 21-07-2008, TER-08-10 (AZB).

Wrangeliaceae: *Lejolisia* sp. Bornet

Described and illustrated in Bornet (1859, pp. 91-92, plates I-II). Thallus filamentous, red, comprising small prostate and erect axes, 2 mm long, attached to the substratum by unicellular rhizoids with digitate pads, 28 µm long, 19 µm wide (Fig. 1.4). Cells of the prostate axes are cylindrical, to 50 µm long and 20 µm broad, each giving rise to

one or two erect axes of cells to 43 µm long and 18 µm broad. Fertile material was not observed preventing specific identification (there are two Atlantic species *Lejolisia mediterranea* Bornet and *Lejolisia exposita* C.W. Schneider & Searles).

This entity was found only once growing on *Corallina elongata* in eulittoral rock pools.
Specimen examined: Pico: São Roque do Pico, 24-07-2007, PIX-07-1586A (AZB).

DISCUSSION

Schmidt (1931) in his first study of the marina algal flora of the Azores listed 137 species. The checklist and distributional index of the benthic marine algae of the North Atlantic Ocean (South & Tittley 1986) increased the total to 186 species for the archipelago. The period of research activity since then has increased the number of species to 377 (54 Chlorophyta, 73 Heterokontophyta (Phaeophyceae) and 250 Rhodophyta). The new records reported here comprise 6 Rhodophyta, 1 Heterokontophyta and 1 Chlorophyta, confirming the predominance of Rhodophyceae in the flora, as elsewhere in Macaronesia. The current total of species recorded from the Azores stands now at 385 (55 Chlorophyta, 74 Heterokontophyta (Phaeophyceae), and 256 Rhodophyta).

In general, most of the species discovered here agree in description with those of previous workers but in some cases there are differences and these require further investigation. Several species were discovered in shallow waters while elsewhere they were known only from deep waters (e.g. *Syringoderma floridana*). The reason for this is unclear but deep water habitats below 30 m have not been surveyed in the Azores. A few sorties using Remotely Operated Vehicles (ROV) have revealed the existence of deep water algal communities down to at least 100 m (cf. Tittley et al. 2001).

The strong warm-water floristic and ecological affinity with the algal flora of the nearer Macronesian islands (cf. Afonso-Carrillo et al. 2006; Tittley & Neto 2006; Tittley et al. 2009) is supported by the new records discussed here. Of the 8 species recorded new to the Azores, *Sebdenia rodrigueziana* and *Syringoderma floridana* extend north their distributional range in the Macaronesian region and the Atlantic Ocean. These species together with *Antithamnionella boergesenii*, *Aphanocladia stichidiosa*, *Sebdenia dichotoma*, and *Codium effusum* extend their distributions westward. The remaining species are within their distributional range.

Species such as *Antithamnionella boergesenii*, *Aphanocladia stichidiosa*, *Coelothrix irregularis*, *Lejolisia* sp., and *Syringoderma floridana* (some with a wide geographical distribution), probably have been overlooked until now because of their small size (less than 50 mm). Many of them are rarities and ephemeral component of the flora.

The present discovery of *Sebdenia dichotoma*, and of *S. rodrigueziana*, recently reported for southern Macaronesia (Haroun et al. 2002) and mainland Portugal (Berecibar et al. 2009), join other species previously considered as endemic to the Mediterranean Sea (e.g., *Eupogodon planus* (C. Agardh) Kützing and *Bryopsis cupressina* J.V. Lamouroux), which are now known to be present in the Atlantic Ocean on the Azores and the Canaries; the latter also in Senegal (Tittley & Neto 2005; Tittley et al. 2009).

It is surprising that *Codium effusum* had not been reported previously in view of the extent of spread of the green pulvinate, felty mats observed at some localities. This species was probably confused with *C. adhaerens*, the only other encrusting species of Codium in the archipelago. Both species grow in the same habitat and are distinguished only by examination under the microscope. The records of new species presented in this paper show the overall mixed nature of the marine algal flora of the Azores with elements shared with other Macronesian archipelagos, the Mediterranean Sea, Atlantic Europe, and subtropical and tropical Atlantic America.

A feature that emerges from the present and earlier papers of this series (Tittley et al. 2001, 2009; Tittley & Neto 2006) is the extension in range distribution to the west of many of the new records found in the Azores. This raises the question as to why some species are amphiatlantic and why the Atlantic seemingly acts a barrier for others? Our approach has been at the alpha taxonomic level but we recognize that investigations at the molecular level will both resolve taxonomic difficulties and help clarify our understanding of

the development and evolution of the Azorean marine algal flora and its floristic relationships. The present series of studies has shown clearly that this isolated island group has a relatively rich benthic marine algal flora of almost 400 species. Many collections await examination and it is likely that this number will be increased, particularly following the taxonomic study of material of the red orders Corallinales, Ceramiales and Nemaliales.

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REFERENCES

Afonso-Carrillo, J. & M. Sansón 1999. *Algas, hongos y fanerógamas marinas de las Islas Canarias. Clave analítica* (1st edition). Servicio de Publicaciones Universidad de La Laguna, La Laguna. 254 pp. [In Spanish].

Afonso-Carrillo, J., S. Pinedo & Y. Elejabeitia 1992. Notes on the benthic marine algae of the Canary Islands. *Cryptogamie, Algologie* 13: 281-290.

Afonso-Carrillo, J., C. Rodríguez–Prieto, F. Boisset, C. Sobrino, I. Tittley & A.I. Neto 2006. *Botryocladia chiajeana* and *Botryocladia macaronesica* sp. nov. (Rhodymeniaceae, Rhodophyta) from the Mediterranean and the eastern Atlantic, with a discussion on the closely related genus *Irvinea*. *Phycologia* 45: 277-292.

Ardré, F. 1970. Contribution à l'etude des algues marines du Portugal I. La Flore. *Portugalia Acta Biologica série B* 10: 137-555. [In French].

Athanasiadis, A. 1996. Morphology and classification of the Ceramioideae (Rhodophyta) based on phylogenetic principles. *Opera Botanica* 127: 1-221.

Athanasiadis A. & A.I. Neto 2010. On the occurrence of *Mesophyllum expansum* (Philippi) Cabioch et Mendoza (Melobesioideae, Corallinales, Rhodophyta) in the Mediterranean, the Canary Isles and the Azores. *Botanica Marina* 53: 333-341.

Berecibar, E., M.J. Wynne, I. Bárbara & R. Santos 2009. Records of Rhodophyta new to the flora of the Iberian Atlantic coast. *Botanica Marina* 52: 217-228.

Bornet, É. 1859. Description d'un nouveau genre de Floridées des côtes de France. *Annales des Sciences Naturelles, Botanique,* Quatrième série 11: 88-92. [In French].

Braune, W. 2008. *Meeresalgen. Ein Farbbildführer zu den verbreiteten benthischen Grün– Braun– und Rotalgen der Weltmeere.* A.R.G. Gantner Verlag, Ruggell. 526 pp. [In German].

Cabioc'h, J., J.–Y. Floc'h, A. Le Toquin, C.–F. Bourdouresque, A. Meinesz & M.Verlaque 2006. *Guide des algues des mers d'Europe* (2nd edition). Delachaux et Niestlé, Paris. 272 pp. [In French].

Codomier, L. 1973. Caractères généraux et développement des spores de *Sebdenia dichotoma* (J. Ag.) Berthold (Rhodophycées, Gigartinales). *Phycologia* 12: 97-105. [In French].

Couto R.P., E.F. Rosas-Alquicira, A.S. Rodrigues & A.I. Neto 2011. *Choreonema thuretii* and *Pneophyllum confervicola* (Corallinales, Rhodophyta), new corallines to the Azores. *Cryptogamie, Algologie* 32: 293-299.

Dawes, C.J. & A.C. Mathieson 2008. *The seaweeds of Florida.* University Press of Florida, Gainesville, Florida. 592 pp.

Díaz-Villa, T., J. Tronholm, J. Afonso-Carrillo & M.Sansón 2004. Adiciones a la flora de algas marinas bentónicas de El Hierro (islas Canarias). *Vieraea* 32: 167-176. [In Spanish].

Guiry, M.D. & G.M. Guiry. (Internet). AlgaeBase. World–wide electronic publication. *National University of Ireland, Galway*, (cited 10 November 2011). Available from: www.algaebase.org/.

Haroun, R.J., W.F. Prud'homme van Reine, D.G. Müller, E. Serrão, & R. Herrera 1993. Deep-water macroalgae from the Canary Islands: new records and biogeographical relationships. *Helgoländer Meeresuntersuchungen* 47: 125-143.

Haroun R.J., M.C. Gil–Rodriguez, J. Díaz de Castro & W.F. Prud'homme van Reine 2002. A Checklist of the marine plants from the Canary Islands (Central Eastern Atlantic Ocean). *Botanica Marina* 45: 139-169.

Haroun, R.J., M.C. Gil–Rodriguez & W. Wildpret de la Torre 2003. *Plantas marinas de las Islas Canarias*.

Canseco Editores, Talavera de la Reina (Spain). 319 pp. [In Spanish].

Henry, E.C. 1984. Syringodermatales ord. nov. and *Syringoderma floridana* sp. nov. (Phaeophyceae). *Phycologia* 23: 419-426.

León-Cisneros, K., R. Riosmena-Rodríguez & A.I. Neto 2011. A re-evaluation of *Scinaia* (Nemaliales, Rhodophyta) in the Azores. *Helgoland Marine Research* 65: 111-121.

Parente, M.I., R.L. Fletcher, A.I. Neto, I. Tittley, A.F. Sousa, S. Draisma & D. Gabriel 2010. Life history and morphological studies of *Punctaria tenuissima* (Chordariaceae, Phaephyceae), a new record for the Azores. *Botanica Marina* 53: 223-231.

Rojas-González, B. & J. Afonso-Carrillo 2003. Morfología y distribución de *Aphanocladia stichidiosa* en las islas Canarias (Rhodophyta, Rhodomelaceae). *Vieraea* 31: 75-82. [In Spanish].

Rosas-Alquicira, E.F., R. Riosmena-Rodríguez, R.P. Couto & A.I. Neto 2009. New additions to the Azorean algal flora, with ecological observations on rhodolith formations. *Cahiers de Biologie Marine* 50: 143-151.

Schmidt, O.C. 1931. Die marine Vegetation der Azoren in ihren Grundzügen dargestellt. *Bibliotheca Botanica* 24: 1-116. [In German].

South, G.R. & I. Tittley 1986. *A checklist and distributional index of the benthic marine algae of the North Atlantic Ocean.* Huntsman Marine Laboratory and British Museum (Natural History), St. Andrews and London. 76 pp.

Taylor, W.R. 1967. *Marine algae of the eastern tropical and subtropical coasts of the Americas* (2nd edition). Ann Arbor: The University of Michigan Press, USA. 870 pp.

Tittley I. & A.I. Neto 2005. The marine algal (seaweed) flora of the Azores: additions and amendments. *Botanica Marina* 48: 248-255.

Tittley, I. & A.I. Neto 2006. The marine algal flora of the Azores: island isolation or Atlantic stepping–stones? *Occasional papers of the Irish Biogeographical Society* 9: 40-54.

Tittley, I., A.I Neto, W.F. Farnham & M.I. Parente 2001. Additions to the Marine Algal (Seaweed) Flora of the Azores. *Botanica Marina* 44: 215-220.

Tittley, I., A.I. Neto & M.I. Parente 2009. The marine algal (seaweed) flora of the Azores: additions and amendments 3. *Botanica Marina* 52: 7-14.

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