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Vegetative and reproductive morphology of *Sargassum orotavicum* sp. nov. (Fucales, Phaeophyceae) from the Canary Islands (eastern Atlantic Ocean)

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Abstract

A population of seaweeds from the Canary Islands successively reported as *Sargassum diversifolium*, *S. vulgare* f. *diversifolium*, or *S. vulgare* was examined monthly at the climax of vegetative and reproductive stage development to evaluate morphological taxonomic features. The primary and secondary blades are morphologically different (primary blades are spirally twisted and sinuous with serrate to nearly entire margins, whereas secondary blades are thinner with entire to slightly dentate-serrate margins); the vesicles are subspherical to slightly oblong, muticous or ending in a mucro or in a coronal blade; and the receptacles are furnished with spines. These characters are not applicable to *Sargassum diversifolium,* or to an infraspecific taxon of *Sargassum vulgare* or *S. furcatum* as previously suggested, and consequently, *Sargassum orotavicum* sp. nov. is described. Nomenclatural problems related to the name *diversifolium* and the affinities of the species involved are presented. According to their morphological characters, *S. orotavicum*, *S. vulgare* and *S. furcatum* belong to the subgenus *Sargassum*. However, *S. vulgare* and *S. furcatum* constitute genuine species of the subsection Cymosae of the section Malacocarpicae, whereas *S. orotavicum* appears related to species of the subsection Biserrulae of the section Acanthocarpicae.

Keywords: Canary Islands; Fucales; macroalgae; *Sargassum orotavicum*; taxonomy.

Introduction

Sargassum C. Agardh is the largest genus in the Phaeophyceae with more than 400 described species occurring throughout most tropical and temperate oceans. It is the ecologically dominant genus in shallow waters in the subtropics and tropics (Kilar et al. 1992). *Sargassum* currently includes erect species consisting of a holdfast with one to several main axes (stipes) with primary branches forming specialized morphological structures such as leaf-like laterals (blades), secondary branches, globose air bladders (vesicles), and fruiting branches (receptacles) (Yoshida 1983, Ang and Trono 1987, Womersley 1987). All these structures exhibit variation in form, size, or number, constituting characters usually used for species separation. Although earlier workers such as J. Agardh (1889) and Grunow (1915, 1916) accepted these morphological characters as sufficiently stable to be used taxonomically, it is widely accepted at present that features such as the shape of blades are highly variable. A large percentage of morphological variation is related to position on the plant, ontogeny (annual, pseudoperennial and perennial species have been reported), seasonality, and environmental factors (Kilar et al. 1992, Silva et al. 1996). Present knowledge of many species of the genus *Sargassum* is largely insufficient because species descriptions are oversimplified and numerous developmental and ecological forms are involved, precluding the establishment of the boundaries between species with certainty (Kilar 1992).

At least twenty-five species of *Sargassum* (plus a similar number of infraspecific taxa) are currently reported from the North Atlantic Ocean (Taylor 1960, Price et al. 1978, Wynne 1998, Gómez-Garreta 2001), and eight species (including several varieties and formas) have been documented from the Canary Islands (Price et al. 1978, Afonso-Carrillo and Sansón 1999). Most of them, however, are problematic with respect to distinctive characters for taxonomic separation (Price et al. 1978). Much of the confusion surrounding the taxonomy of *Sargassum* on Atlantic coasts can be attributed to a lack of information on the development of the vegetative and reproductive features (Kilar and Hanisak 1988). For Kilar et al. (1992), studies on populations of mature thalli are critical for establishing a clear definition of species based on a satisfactory knowledge of the intraspecific variation of the characters with taxonomic value.

As a first step towards resolving the taxonomy of this genus in the eastern Atlantic Ocean, we studied the morphological variations in a population previously identified as *Sargassum vulgare* f. *diversifolium* Grunow or as *S. vulgare* C. Agardh, names usually used to refer to a seaweed widely distributed in the Canary Islands (Børgesen 1926, Gil-Rodríguez and Afonso-Carrillo 1980, Afonso-Carrillo and Sansón 1999). Thalli from populations of Puerto de la Cruz (Tenerife, Canary Islands), however, exhibited an ensemble of features different from that used in the characterization of *S. vulgare* f. *diversifolium*, but in addition, these characters were not in agreement with the current concept of *S. vulgare*. In the present report we evaluate the morphological diagnostic features of fully developed mature thalli to be used in the characterization of a new species. Seasonal patterns of morphological variability will be reported later (Díaz-Villa et al. unpublished data).

Materials and methods

Populations of the new species of *Sargassum* grow in exposed tide pools in the lower eulittoral zone at Puerto de la Cruz, north of Tenerife, Canary Islands (28° 24′N, 16° 34′W). Other species growing in this habitat were *Pterocladiella capillacea* (Gmelin) Santelices *et* Hommersand, *Cystoseira compressa* (Esper) Gerloff *et* Nizamuddin and *Ulva rigida* C. Agardh. Ten to fifteen specimens were randomly collected monthly from March to July 2002, when all thalli were fully developed. Specimens were placed in plastic bags and preserved in 4–10% formalin in seawater. Morphological features of holdfast, stipes, primary and secondary branches, primary and secondary blades, cryptostomata, vesicles and receptacles were examined. For each thallus, size and number of holdfast, stipes and primary and secondary branches were recorded, as well as shape and number of vesicles. Size and shape of primary and secondary blades were examined in all blades of two individual thalli and in the largest blade from each primary branch of each thallus. Number, diameter and arrangement of cryptostomata were obtained from two blades from each thallus. Vesicle size was measured in the largest vesicle from each primary branch. Receptacles size, number of branches and number of spines were noted in all receptacles from a secondary branch of four individual specimens. Selected specimens were deposited in the Herbarium TFC (Departamento de Biología Vegetal, Universidad de La Laguna, Canary Islands). Herbarium abbreviations follow Holmgren et al. (1990).

Results

Vegetative morphology

Habit Thalli examined belong to a pseudoperennial species, with bushy erect shoots, greenish-brown in colour, reaching up to 62 cm in height when mature (throughout spring). Mature thalli consist of a holdfast, stipes, and primary branches which support primary blades, secondary branches, secondary blades, vesicles and receptacles (Figure 1). Throughout late summer and almost all autumn, thalli survive but are reduced to the holdfast, stipes, and short primary branches that retain only few primary blades.

Holdfasts and stipes Holdfasts are discoid-conical, (5–)13–25 mm in diameter (Figure 2), although some of them may become confluent and partially fused in dense populations. Holdfasts are dark brown in colour and exhibit a smooth or slightly rough surface. Usually, a single stipe rises from each holdfast, more rarely two or three, but occasionally up to six stipes were observed on the largest and oldest holdfasts (Figure 3). Stipes are also dark brown, 4–16(–42) mm long (Figure 4), slightly verrucose, terete, (2–)3–4(–8) mm in diameter (Figure 5), decreasing gradually and distally in diameter; they are simple or up to six times branched, giving rise to few blades and distal primary branches in a spiral sequence, (1–)2–7(–16) (Figure 6). Occasionally, however, some stipes remain completely naked.

Primary and secondary branches Primary branches are erect, greenish-brown, terete, up to 462 mm long and 2(–3) mm in diameter in mature fertile thalli. Only one or two (rarely three) of the primary branches that rise from a stipe grow and produce receptacles, the rest remain as sterile primary branches, less than 150 mm long. The surface of primary branches is smooth, and rarely develops scattered spines at the proximal portions of thalli, but the terminal regions of mature thalli have primary branches with densely spinous surfaces. Spines are simple, rarely forked, acute, reaching up to 1 mm in length (Figure 7). Most spines are quickly lost, and in large senescent specimens few spines are retained on primary branches. Loss of spines does not leave any apparent scars on the surfaces of the branches. Primary blades are formed laterally from the primary branches in a regular spiral sequence. Secondary branches arise from the axils of some of the primary branches. Secondary branches are similar in morphology to primary branches, although shorter, up to 100 mm long, but reaching a greater length when replacing a damaged primary branch. Deciduous spines, of size and shape equivalent to those previously described, are common throughout the secondary branches. Secondary blades, vesicles and receptacles are formed exclusively from the secondary branches.

Blades Blades are borne mainly from primary and secondary branches, although some may issue directly from stipes. Blades formed from stipes are similar in morphology to the more proximal primary blades, and are commonly branched (Figure 8). Blades of primary branches (primary blades) are alternately, spirally and densely arranged, with successive blades separated at intervals of 3–5 mm in the middle portions of the thalli. Mature primary blades are lanceolate to linear-lanceolate (Figure 9), (15–)30–40(–65) mm long and (4–)5–9(–11) mm wide (mean ratio length/width=5.3) (Figures 11–13), narrower and shorter at youngest terminal portions of thalli, and exhibit characteristic asymmetrical bases (Figure 9). A distinct midrib runs from the base of each blade to the acute tip and, very rarely, an alate or flat lateral expansion is present in the proximal portion. Most of primary blades are simple but more basal blades can form up to three lateral branches. Primary blades are flat to spirally twisted, with the margin serrate to nearly entire and frequently sinuous (Table 1). Primary blades have a flattened short stalk (1–2 mm long), commonly with one or two opposite spines arising parallel to the blade plane (Table 1).

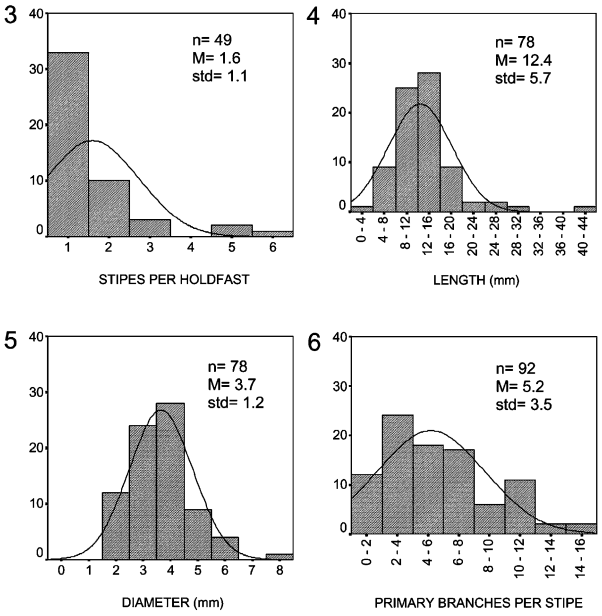
Secondary blades are more densely arranged than primary blades, with 1–2 mm spacing. They are simple, linear to lanceolate (Figure 10), (7–)15–40(–50) mm long and (2)4–6(–8) mm wide (mean ratio length/width: 5.7) (Figures 14–16), asymmetric at their bases, flat, usually non-sinuous, with entire to slightly dentate-serrate margins (Table 1). Stalks are similar in shape and size to those of primary blades, but spines are less frequent (Table 1).

Cryptostomata Cryptostomata are common on blades and occasionally on vesicles. They are numerous

Figures 1, 2 *Sargassum orotavicum* sp. nov.
(1) Habit of the holotype specimen (TFC Phyc 11680). Scale bar=5 cm. (2) Detail of a holdfast from which a stipe arises. Scale bar=1 cm.

and mostly arranged in one or two rows on each side of the midrib in thin primary blades from distal regions, becoming irregularly scattered in wide primary blades from basal regions. Cryptostomata in secondary blades are arranged in the pattern previously described for primary blades, although they are usually less abundant and their diameters are larger. Cryptostomata are elliptical, 24–198×14–148 μm in diameter.

Vesicles Vesicles are numerous in mature thalli and arranged densely in the secondary branches, where every third secondary blade can support an axillary vesicle (Figure 17). Individual vesicles are borne in axils of secondary blades or replace them. Vesicles are from subspherical to slightly oblong, muticous, mucronate or ending in a short coronal blade (Figure 18), ranging from (2–)6–7(–9) mm long and (2–)4–7(–8) mm in diameter



Figures 3–6 *Sargassum orotavicum* sp. nov.: frequencies of stipe features.
(3) Number of stipes per holdfast. (4) Length of stipes. (5) Diameter of stipes. (6) Number of primary branches per stipe (n=sample size, M=mean, std=standard deviation).

Figure 7 *Sargassum orotavicum* sp. nov. Details of primary branches showing simple and branched spines. Scale bar=5 mm.

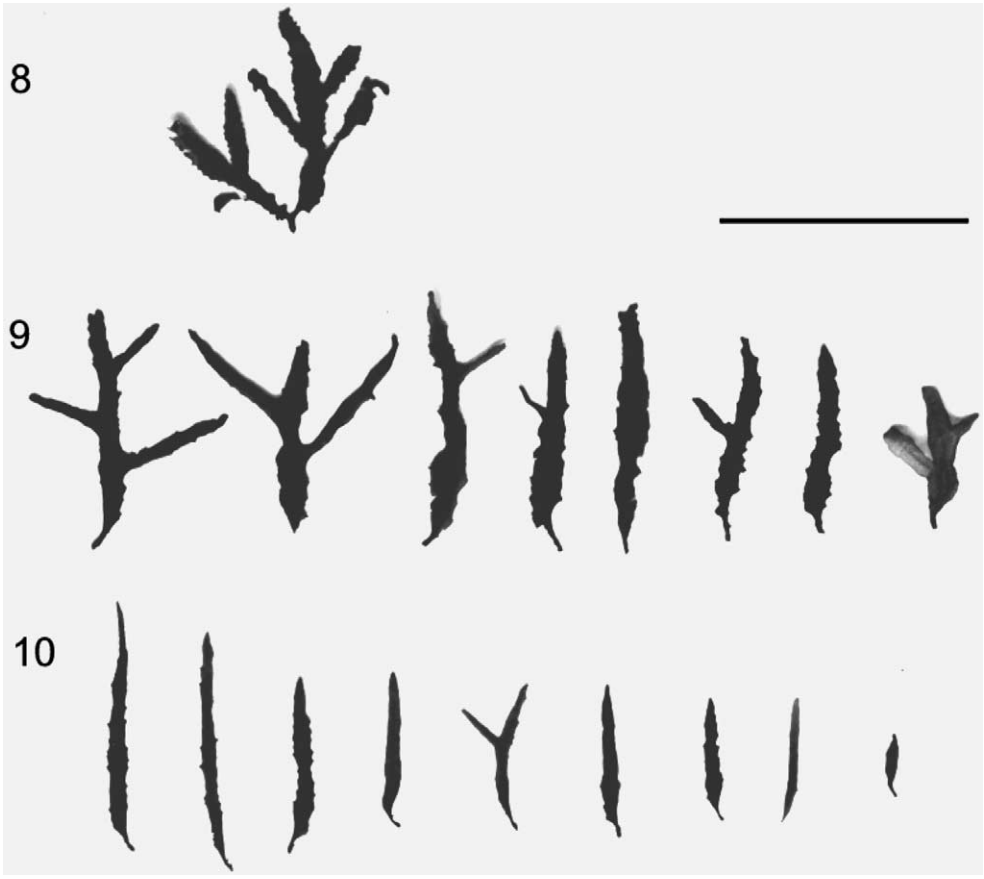
(Figures 19, 20). Almost half of the vesicles examined terminated in a mucro or a short blade (Table 1). Vesicles are terminal on a simple (very rarely branched), slender, terete or flattened, smooth or occasionally spinous stalk, 3–6 mm long (Figure 21).

Reproductive morphology

Receptacles Thalli are androgynous in gametangial distribution (i.e., male and female gametangia occur in different conceptacles but in the same receptacle) and receptacular branchlets arise from the axils of secondary blades or vesicles. Receptacular branchlets are 10–25 mm long consisting of (1–)3–5(–9) receptacles densely arranged in an alternate-spiral sequence throughout the receptacular axis. Individual receptacles are erect, terete, up to 17 mm long and (0.3–)1–2 mm in diameter, and arise from the axil of a minute linear blade (10–30 mm long and 1–3 mm wide), or a minute vesicle (2–4 mm in diameter). Each receptacle forms a dense cluster with an apparently dominant axis which is branched from the base and supports 1–7 lateral branches (Figures 22, 25). Lateral branches are simple or 1–2 times forked, ending in acute tips. Conceptacles develop acropetally covering the receptacle almost entirely and only a short pedicel remains sterile in fully developed receptacles. Both immature and mature receptacles are usually spinous (Table 1). However, spines are lost, being absent or rare in senescent receptacles. Spines are acute, up to 0.5 mm long (Figure 23), and occur 1–3(–30) in a single mature receptacle (Figure 26). Female conceptacles are distinguished, in surface view, by their wide ostiole and their dark brown colour (originating from the oogonia within). A hyaline plug in the ostiole closes female conceptacles until egg liberation. After release, eggs are retained in mucilage around the receptacles (Figure 24). Male conceptacles are smaller, brown, and their narrow ostiole is not apparent in surface view. Occasionally, some cryptostomata from minute blades and vesicles from receptacular branchlets were found transformed into well developed female conceptacles.

Discussion and conclusion

The main morphological characters used in the separation of species in *Sargassum* are length of thallus, size and shape of holdfast, stipes, branches, blades (including blade margin and distribution of cryptostomata), vesicles and receptacles, presence/absence of spines on vegetative or reproductive structures, sexuality and maturation period (Yoshida 1983). Species of *Sargassum,* however, exhibit a high morphological variability related to ontogeny, seasonality, and environmental factors (Kilar et al. 1992). Thus, fully developed thalli should be used in taxonomic determinations in order to reduce temporal variation (Taylor 1960). And only morphological features with taxonomic value representing the whole population rather than an individual specimen are acceptable (Kilar 1992). The present study complies with both recommendations, thus the results permit characterization of specimens by evaluating variability of vegetative and reproductive characters.



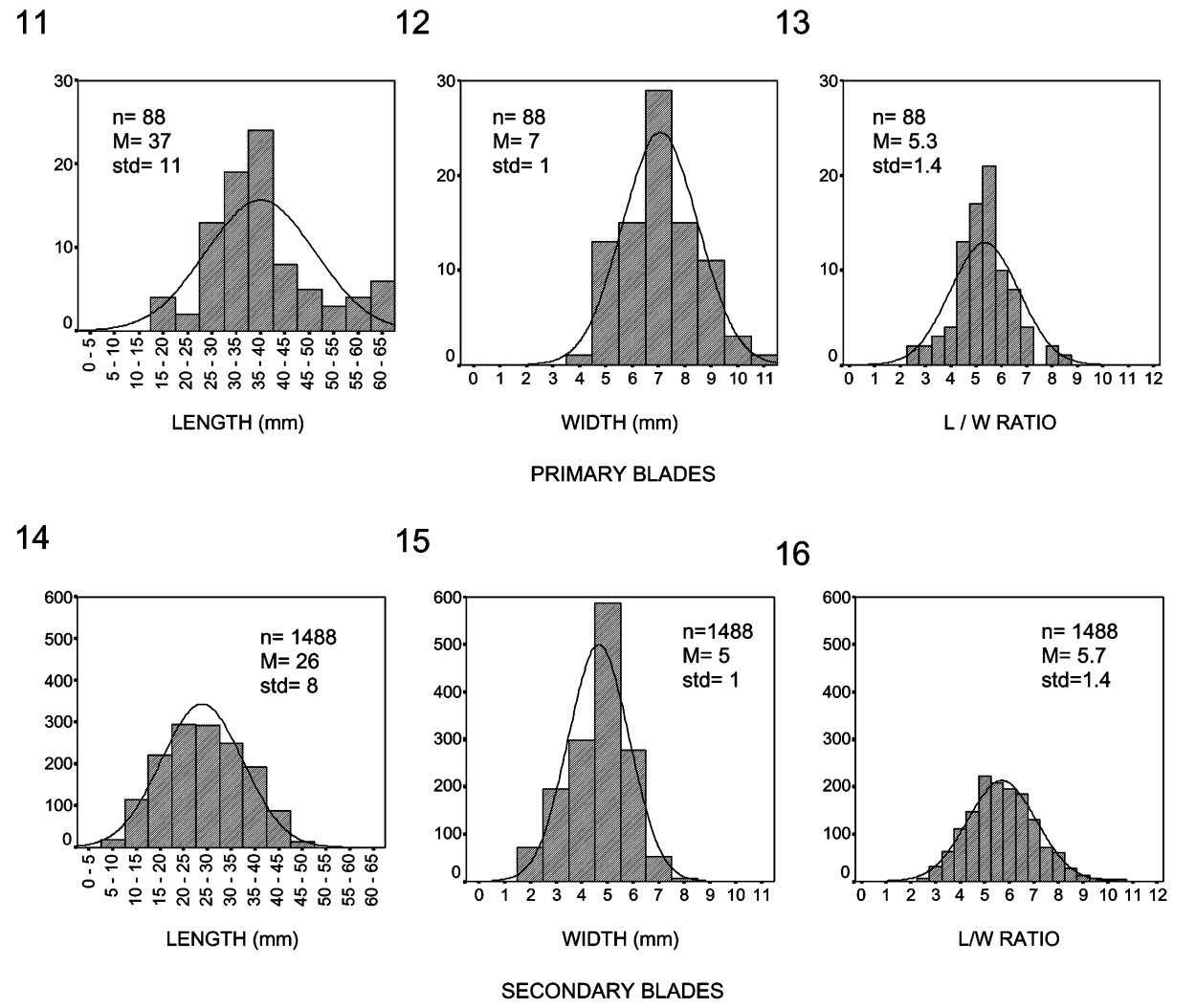
Figures 8–10 *Sargassum orotavicum* sp. nov. Size and shape variation of blades. (8) A caulinar blade. (9) Primary blades. (10) Secondary blades. Scale bar=5 cm.

Among the suite of morphological features exhibited by the specimens examined, several characters require additional comment because they are not in agreement with the current concepts of *Sargassum vulgare* and *S. vulgare* f. *diversifolium*, viz. size and shape of primary and secondary blades, the size and shape of vesicles, and presence of spines on the receptacles. Most blades from fully developed specimens are linear-lanceolate in shape but primary blades are longer and wider than secondary blades. Moreover, primary blades are spirally twisted and sinuous with serrate to nearly entire margins, and two opposite spines commonly occur on stalks, whereas secondary blades are thinner with entire to slightly dentate-serrate margins, and stalks are less frequently spinous. In species of *Sargassum* with morphological differences between primary and secondary blades, a correct description of both is essential so that the blade-related features can be used as diagnostic characters (Yoshida 1983). The frequencies of the different morphological features of primary and secondary blades (Table 1) are sufficiently high for them to be used with confidence as diagnostic characters.

Vesicles in specimens examined are from subspherical to slightly oblong in shape and exhibit three of the six variations in vesicle morphology described by Yoshida (1983) for species of *Sargassum*. Mutic vesicles, mucronate vesicles and vesicles ending in a short coronal blade occur in a single specimen. Most vesicles are mutic, but the frequencies of the different morphological types are sufficiently stable within the population to be used in the taxonomic characterization of this species (Table 1).

Receptacles occur in dense clusters ending in simple or forked spinous lateral branches. Spines are only absent in the senescent receptacles but their high frequency in mature receptacles confers a high value on this morphological character, which has been considered as a relevant taxonomic feature (Setchell 1931). Montagne (1841) was the first to observe spines on the receptacles in some *Sargassum* specimens from the Canary Islands that he identified as *S. diversifolium* (Turner) C. Agardh. Probably, the heterogeneous collection of specimens examined by Montagne (1841) included thalli possessing the morphological features observed in this study, but, as they were not present in all specimens, he considered the spinous nature of receptacles not to be a constant character, and consequently without taxonomic value. This feature has not been reported subsequently.

The suite of features shown by the specimens examined in the present study precludes assignment to *Sargassum vulgare* or to *S. vulgare* f. *diversifolium* Grunow (1916) as previously recognized (Børgesen 1926, Pinedo et al. 1992, Afonso-Carrillo and Sansón 1999). Although *S. vulgare* is presently a taxonomic complex that includes many poorly known varieties and formas deserving careful taxonomic study (Ribera et al. 1992), the taxonomic characteristics that circumscribe the type variety (var. *vulgare*) have been described by numerous authors (i.e., C. Agardh 1820, Taylor 1960, Gómez-Garreta 2001). Diag-



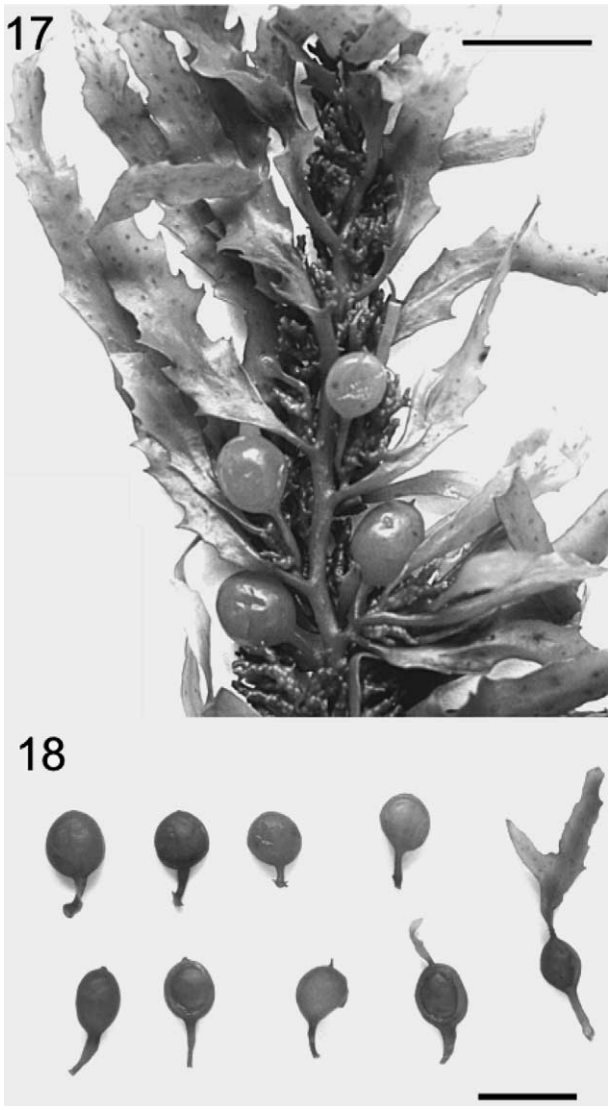
Figures 11–16 *Sargassum orotavicum* sp. nov.: frequencies of blade features.
(11) Length of primary blades. (12) Width of primary blades. (13) Length/width ratio of primary blades. (14) Length of secondary blades. (15) Width of secondary blades. (16) Length/width ratio of secondary blades (n=sample size, M=mean, std=standard deviation).

Table 1 *Sargassum orotavicum* sp. nov.: frequencies of characters from primary blades, secondary blades, vesicles and receptacles.

	Primary blades (n=88)	Secondary blades (n=1488)
Branched	0.136	0.019
Sinuous	0.898	0.173
Spinous stalk	0.795	0.446
Alate midrib	0.011	0.007
Margin entire	0.057	0.307
Margin dentate	0.045	0.216
Margin serrate	0.898	0.477
	Vesicles (n=1078)	
Simple stalk	0.978	
Branched stalk	0.022	
Muticous	0.536	
Mucronate	0.424	
With coronal blade	0.040	
	Receptacles (n=287)	
Spinous	0.854	
Non-spinous	0.146	

nostic characters of *S. vulgare* var. *vulgare* include the following features: (1) blades relatively short [2–4(–6) mm wide and 15–30(–40) mm long], not twisted, with a sharply serrate margin (mainly in secondary blades), and lacking spines on stalk; (2) vesicles spherical [(2.5)–3–4.5(–5) mm diameter], non-apiculate, terminal in short stalks (0.5–2 mm long); and (3) receptacles lack spines (Taylor 1960, Schnetter 1976, Coppejans 1983, Gómez-Garreta 2001). All these characters are absent in thalli examined in this study. *Sargassum vulgare* f. *diversifolium* differs from the type variety by its smaller habit and by its usually divided proximal blades (Grunow 1916), and therefore it is different from the specimens studied here.

The characters exhibited by the specimens from Puerto de la Cruz also prevent attribution to a forma of *Sargassum furcatum* Kützing as proposed by Yoneshigue (1985), who transferred *S. vulgare* f. *diversifolium* Grunow to *S. furcatum*, as *S. furcatum* f. *diversifolium* (Grunow) E.J. de Paula *ex* Yoneshigue. Although this new combination was not validly published, *Sargassum furcatum* is similar to *S. vulgare* in vesicle and receptacle morphologies, differing mainly by its usually branched blades

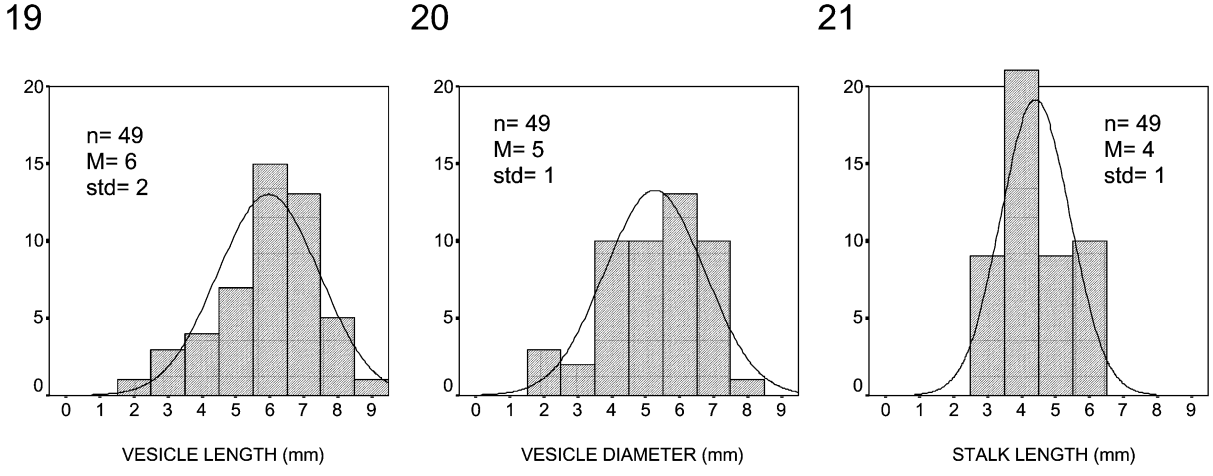


Figures 17, 18 *Sargassum orotavicum* sp. nov.: vesicles. (17) Detail of a primary branch showing the arrangement of vesicles. (18) Morphological types of vesicles. Scale bars=1 cm.

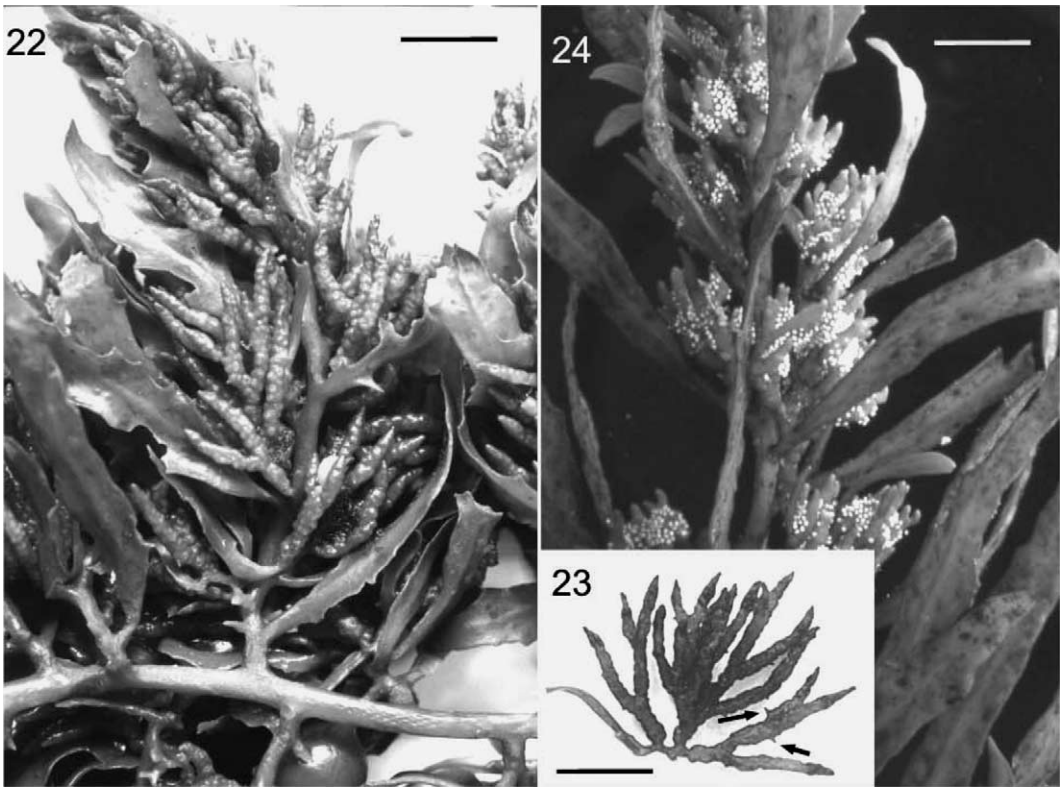
(Taylor 1960), and therefore it is in disagreement with specimens studied here.

Specimens studied here were collected in the same locality (Puerto de la Cruz is the current name of the locality referred as Puerto Orotava in older phycological literature; see Pinedo et al. 1992) where at least Sauvageau (1912, as *Sargassum vulgare* var. *diversifolium*), Børgesen (1926, as *S. vulgare* f. *diversifolium*) and Pinedo et al. (1992, as *Sargassum vulgare*) made collections. Sauvageau (1912: 304) only examined immature specimens (with few blades, and lacking vesicles and receptacles) collected during autumn-winter which he referred to as *S. vulgare* var. *diversifolium,* based on unpublished information obtained from identifications made by Grunow in material from the Canary Islands deposited in the Herbarium Thuret (Muséum National d'Histoire Naturelle, Paris). Grunow had examined, among other materials, the Canarian specimens identified by Montagne (1841) as *Sargassum diversifolium*, a species described by C. Agardh (1820: 29) based on *Fucus diversifolius* Turner (1809: pl. 103) from the coast of Egypt (eastern Mediterranean Sea). Kützing (1849, 1861) accepted the identifications made by Montagne (1841), but J. Agardh (1889) referred to *S. diversifolium* as an exclusively Mediterranean species characterized by receptacles without spines. When Grunow (1916) established *Sargassum vulgare* f. *diversifolium* (as "*diversifolia*"), based on specimens from the Canary Islands, Madeira and Azores, he did not propose a new combination because he was not sure that specimens from the Atlantic islands and *Fucus diversifolius* Turner were the same taxonomic entity. Establishment of the name *Sargassum vulgare* f. *diversifolium* by Grunow (1916) for entities previously referred to as *S. diversifolium*, but which were unrelated by nomenclature, was an unfortunate decision that has generated confusion.

Børgesen (1926) also examined incomplete specimens collected during autumn-winter. But, although he followed Grunow (1916) in identifying the specimens as *Sargassum vulgare* f. *diversifolium*, he only observed vegetative features, such as the deeply forked blades, which he presented as the most distinguishing character for this taxon. Deeply forked blades had been pointed



Figures 19–21 *Sargassum orotavicum* sp. nov.: frequencies of vesicle features. (19) Vesicle length. (20) Vesicle diameter. (21) Stalk length (n=sample size, M=mean, std=standard deviation).



Figures 22–24 *Sargassum orotavicum* sp. nov.: receptacles.
(22) Detail of a secondary branch showing fully developed receptacles. (23) Detail of a receptacle furnished with spines (arrows). (24) Detail of a secondary branch with eggs retained in mucilage around the receptacles. Scale bars=5 mm.

out and illustrated by Turner (1809) in *Fucus diversifolius.* Because of this, Børgesen (1926) erroneously considered *Sargassum diversifolium* (Turner) C. Agardh as a homotypic synonym of *S. vulgare* f. *diversifolium* Grunow.

Use of the name *diversifolium* for specimens from the Mediterranean Sea needs commenting. When Hamel (1939) treated *Sargassum salicifolium* J. Agardh as a synonym of *S. vulgare* he transferred to this last species a forma *diversifolium* that had been created by Grunow (1916: 149, as "*diversifolia*"), based on *S. diversifolium* Bory (1832) from Greece, a taxon considered by Grunow as different from *Fucus diversifolius* Turner. Both *Sargassum diversifolium* Bory (1832) and *S. vulgare* f. *diversifolium* (Bory) Hamel (1939) are illegitimate names. They are homonyms of the previous *S. diversifolium* (Turner) C. Agardh (1820) and *S. vulgare* f. *diversifolium* Grunow (1916), respectively.

Morphological differences found between *Sargassum vulgare* and specimens from Puerto de la Cruz are substantial, and allow us to consider these taxa as very distinct species. Through possession of cylindrical branches and leaf-like blades, both *S. vulgare* and specimens examined here belong to the subgenus *Sargassum* (Setchell 1931, Womersley 1987). According to Abbott et al. (1988), subgenus *Sargassum* includes three sections: Zygocarpicae (J. Agardh) Setchell (receptacles supporting blades and vesicles), Malacocarpicae (J. Agardh) Abbott, Tseng *et* Lu (receptacles smooth), and Acanthocarpicae (J. Agardh) Abbott, Tseng *et* Lu (receptacles spinous or dentate). *S. vulgare* constitutes a genuine species of the subsection Cymosae (J. Agardh) Tseng *et* Lu of the Malacocarpicae, as was shown by J. Agardh (1889) and Grunow (1916). However, our specimens appear related to species of the subsection Biserrulae (J. Agardh) Tseng *et* Lu of the Acanthocarpicae (see Tseng and Lu 1997). *Sargassum furcatum* also belongs to the subsection Cymosae.

Among the approximately 25 species of *Sargassum* reported in the Atlantic Ocean, only three possess spines on the receptacles. These are: *S. hornschuchii* C. Agardh from the Mediterranean Sea (Hamel 1939), *S. hystrix* J. Agardh from the Caribbean Sea and Brazil (Taylor 1960, Wynne 1998) and two single reports from the eastern Atlantic Ocean (Senegal and Sierra Leone) both considered as doubtful records by Lawson and John (1982), and *S. platycarpum* Montagne from the Caribbean Sea and Brazil (Taylor 1960, Wynne 1998) and the Cape Verde Islands in the eastern Atlantic Ocean (Price et al. 1978). The Canarian specimens do not agree with any of these species. *Sargassum hornschuchii* differs mainly by its wider blades, larger vesicles and compressed receptacles (Hamel 1939). *S. hystrix* has acutely serrate oblong-elliptical blades, usually mucronate vesicles and palmate receptacles with subterete or flattened lobes (Taylor 1960). *S. platycarpum* differs by its coarsely serrate shorter lanceolate blades, compressed stalks of vesicles and compressed, triangular in section, receptacles (Taylor 1960).

Specimens from Puerto de la Cruz present a suite of features not previously described for any of the species reported for the Atlantic Ocean and they seem to differ also from all other species assignable to *Sargassum*. Although we are reluctant to propose a new species in a genus as poorly understood as *Sargassum*, we believe

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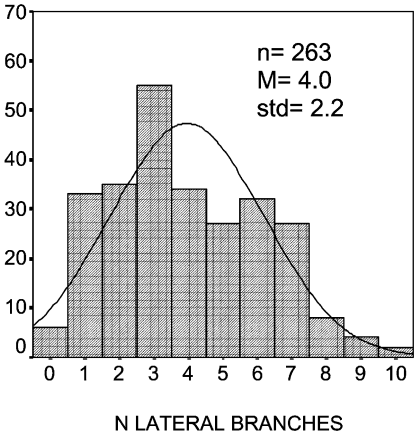

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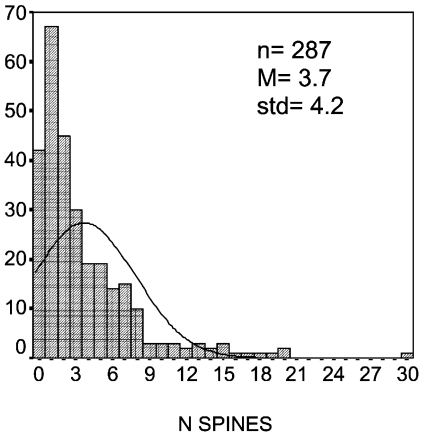

Figures 25, 26 *Sargassum orotavicum* sp. nov.: frequencies of receptacle features.
(25) Number of lateral branches per receptacle. (26) Number of spines per receptacle (n=sample size, M=mean, std=standard deviation).

that these specimens constitute an undescribed entity and it is best to treat them as a new species.

***Sargassum orotavicum* Díaz-Villa, Afonso-Carrillo *et* Sansón sp. nov.**

Diagnosis *Plantae brunneo-virides, erectae, densae, usque 62 cm altae. Haptera discoidea-conica, (5–)13–25 mm diametro. Rami primarii cylindrici usque 46.2 cm alti, 2(–3) mm diametro, dense spinosi in regionibus terminalibus. Laminae primariae lanceolatae vel lineari-lanceolatae* [*(15–)30–40(–65) mm longae, (4–)5–9(–11) mm latae*] *spiraliter ondulatae et sinuosae, cum marginibus a sectis usque ad fere integros. Pleraenque laminae primariae sunt simplices sed magis basales possunt formare usque ad tres ramos laterales. Laminae secundariae lineares vel lanceolatae* [*(7–)15–40(–50) mm longae, (2–)4–6(–8) mm latae*] *cum marginibus integris vel leviter dentato-sectis. Cryptostomatae dispersae. Vesiculae subsphaericae vel oblongae* [*(2–)6–7(–9) mm longae, (2–)4–7(–8) mm diametro*], *muticatae, mucronatae vel terminatae in lamina. Plantae androgynae, pseudoperennes, maturante per tempus vernale. Receptacula racemis, erectis, cylindrica, usque 17 mm longa, (0.3–)1–2 mm diametro, cum spinis acutis usque 0.5 mm longis.*

Thalli greenish-brown, erect, bushy, up to 62 cm high. Holdfasts discoid-conical, (5–)13–25 mm in diameter. Primary branches terete, up to 46.2 cm long and 2(–3) mm in diameter, densely spinous at terminal regions. Primary blades lanceolate to linear-lanceolate [(15–)30–40(–65) mm long and (4–)5–9(–11) mm wide] spirally twisted and sinuous with serrate to nearly entire margins. Most primary blades are simple but more basal blades can form up to three lateral branches. Secondary blades linear to lanceolate [(7–)15–40(–50) mm long and (2–)4–6(–8) mm wide] with entire to slightly dentate-serrate margins. Cryptostomata dispersed. Vesicles subspherical to slightly oblong [(2–)6–7(–9) mm long and (2–)4–7(–8) mm in diameter], muticous or ending in a mucro or in a coronal blade. Thalli androgynous, pseudoperennial, maturing throughout spring. Receptacles in erect clusters, terete, up to 17 mm long and (0.3–)1–2 mm in diameter, furnished with acute spines up to 0.5 mm long.

Holotype and type locality TFC Phyc 11680 (Figure 1). Exposed tide pool at lower eulittoral, Puerto de la Cruz, Tenerife, Canary Islands, 28 April 2002; *leg*. Julio Afonso-Carrillo. Paratypes: TFC Phyc 11681 (Puerto de la Cruz, Tenerife, Canary Islands, 30 May 2002; *leg*. Julio Afonso-Carrillo) at L, and TFC Phyc 11682 (Puerto de la Cruz, Tenerife, Canary Islands, 29 June 2002; *leg*. Julio Afonso-Carrillo) at PC.

Etymology The specific epithet refers the old name (Puerto Orotava) of the type locality Puerto de la Cruz, as it is referred in the older phycological literature [e.g., Sauvageau (1912), Børgesen (1926)].

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