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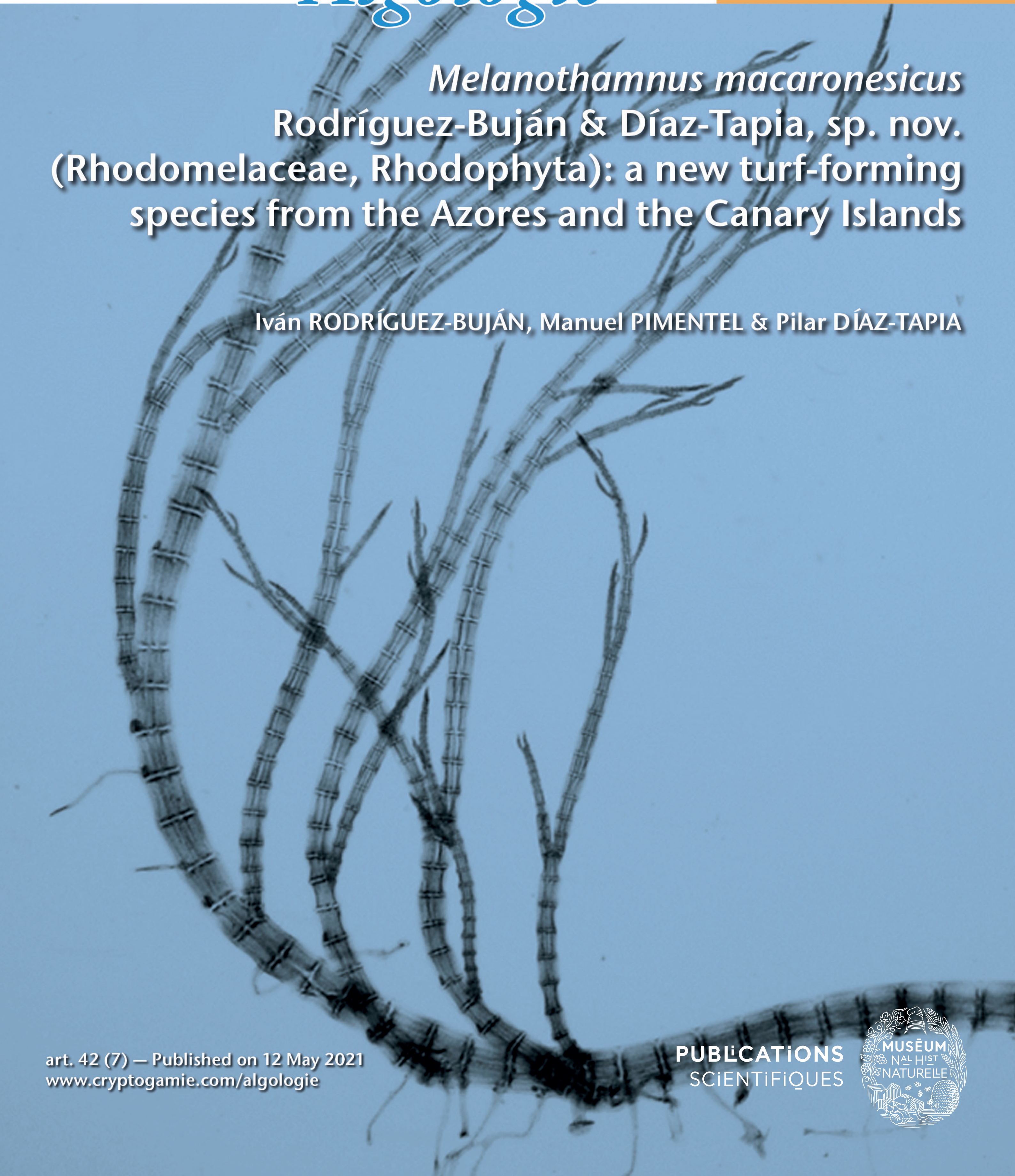
Melanothamnus macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov. (Rhodomelaceae, Rhodophyta): a new turf-forming species from the Azores and the Canary Islands

Iván RODRÍGUEZ-BUJÁN, Manuel PIMENTEL & Pilar DÍAZ-TAPIA



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Melanothamnus macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov. (Rhodomelaceae, Rhodophyta): a new turf-forming species from the Azores and the Canary Islands

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new species.

ABSTRACT

The use of molecular tools in red algal diversity surveys often reveals the existence of undescribed species. Here, we report a new Macaronesian turf-forming red alga in the otherwise mostly Pacific genus *Melanothamnus* Bornet & Falkenberg. This new taxon, *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. is described based on morphological and molecular (*rbc*L gene) evidence. Morphologically, it differs from other *Melanothamnus* taxa by a combination of characters that includes its decumbent habit with an extensive system of prostrate axes, small size (≤2.5 cm), four ecorticate pericentral cells, unbranched to once-branched trichoblasts and spermatangial branches formed on the first dichotomy of trichoblasts that have a sterile apical cell. Molecularly, this new species differs from its congeners by sequence divergence ≥3.3% in the *rbc*L gene. Current known distribution of *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. is restricted to Macaronesia, suggesting that it could be endemic to this archipelago. Our findings suggest that endemicity among red algae might be more common than previously thought in this bioregion, particularly among easily overlooked turf-forming species.

RÉSUMÉ

Melanothamnus macaronesicus *Rodríguez-Buján & Díaz-Tapia, sp. nov. (Rhodomelaceae, Rhodophyta) : une nouvelle espèce gazonnante dans les Açores et les îles Canaries.*
L'utilisation d'outils moléculaires dans les suivis de diversité des algues rouges révèle souvent l'existence d'espèces non décrites. Ici, nous rapportons une nouvelle algue rouge de Macaronésie formant un gazon du genre *Melanothamnus* Bornet & Falkenberg, dont la distribution est principalement Pacifique. Ce nouveau taxon, *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov.

MOTS CLÉS
Gazons algaux,
endémisme,
Macaronésie,
morphologie,
diversité négligée,
phylogénie,
Polysiphonia,
*rbc*L,
Streblocladieae,
espèce nouvelle.

est décrit sur la base de preuves morphologiques et moléculaires (gène *rbc*L). Morphologiquement, il diffère des autres taxons de *Melanothamnus* par une combinaison de caractères qui incluent son port décombant avec un système étendu d'axes prostrés, sa petite taille (≤ 2,5 cm), quatre cellules péricentrales écortiquées, des trichoblastes non ramifiés à une fois ramifiés et des rameaux spermatangiaux formés sur la première dichotomie des trichoblastes qui ont une cellule apicale stérile. Moléculairement, cette nouvelle espèce diffère de ses congénères par une divergence de séquence ≥ 3,3 % dans le gène *rbc*L. La distribution actuelle connue de *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. est limitée à la Macaronésie, ce qui laisse à penser qu'elle pourrait être endémique à cet archipel. Nos résultats suggèrent que l'endémicité parmi les algues rouges pourrait être plus fréquente qu'on ne le pensait auparavant dans cette biorégion, en particulier parmi les espèces formant des gazons, facilement négligées.

INTRODUCTION

More than 7000 red algal species have been described (Guiry & Guiry 2020), representing only an estimated *c.* 50% of the total diversity (Guiry 2012). Cryptic species are common among the Rhodophyta with simpler morphologies (Van-Oppen *et al.* 1996), especially in lineages displaying a strong morphological convergence that breaks the positive correlation between genetic and morphological differentiation (Mineur *et al.* 2012; Verbruggen 2014).

The Rhodomelaceae is the most diverse family of the Rhodophyta, with the tribes Polysiphoniae and Streblocladieae covering much of that diversity (Díaz-Tapia *et al.* 2017a). Most members of these tribes are small in size (<3 cm) and morphologically similar, and several groups of species share many of the diagnostic characters that are relevant for the delineation of taxa (Stuercke & Freshwater 2008; Savoie & Saunders 2015, 2018; Díaz-Tapia *et al.* 2020a). The identification of species in these rhodomelacean tribes usually requires detailed micro-morphological studies as well as molecular analyses, essential when taxa are morphologically indistinguishable. High diversity, small size and phenotypic conservatism render the tribes Polysiphonieae and Streblocladieae good candidates for hosting undiscovered and cryptic species. The combination of molecular and morphological studies provides the best tool to explore taxonomic diversity within morphologically similar red algal lineages (e.g. Stuercke & Freshwater 2010; Saunders *et al.* 2017; Soares *et al.* 2019; Díaz-Tapia *et al.* 2020b; Rodríguez-Prieto *et al.* 2020).

Genus *Melanothamnus* Bornet & Falkenberg (Rhodomelaceae; Streblocladieae) was originally defined as monotypic, including only *M. somalensis* Bornet & Falkenberg. Díaz-Tapia *et al.* (2017b) proposed a new circumscription for this genus based on phylogenetic studies, and 46 species formerly placed in *Kintarosiphonia* S.Uwai & M.Masuda, *Fernandosiphonia* Levring, *Neosiphonia* M.S.Kim & I.K.Lee and *Polysiphonia* Greville were transferred to *Melanothamnus*. This genus is differentiated from other similar genera by two synapomorphies: the presence of three cells in the carpogonial branch (other Rhodomelaceae have four); and the arrangement of plastids only on the radial walls of pericentral cells (other Rhodomelaceae have plastids also on the outer cell walls) (Díaz-Tapia *et al.* 2017b). Eleven (20%) out of the 56 currently recognized species in *Melanothamnus* were discovered in the last 11 years (Mamoozadeh & Freshwater 2012; Bustamante *et al.* 2012, 2013a, b; Muangmai *et al.* 2014; Kim & Kim 2016; Díaz-Tapia *et al.* 2017c; Huisman 2018; Woodworth *et al.* 2019; Serio *et al.* 2020), suggesting that its diversity has been greatly underestimated.

Melanothamnus is distributed in most coastal areas worldwide, but it is far more diverse in the northwestern Pacific (Díaz-Tapia *et al.* 2017b). In Macaronesia, a group of volcanic archipelagos in the North Atlantic, this genus is represented by five species (Haroun *et al.* 2002; Freitas *et al.* 2019). Two of these taxa [*M. collabens* (C.Agardh) Díaz-Tapia & Maggs and *M. harveyi* (Bailey) Díaz-Tapia & Maggs] are considered as cryptogenic or introduced in the Atlantic (McIvor *et al.* 2001; Díaz-Tapia *et al.* 2017b; but for alternative interpretations of *M. harveyi*/*japonicus* distribution see Kim & Yang 2006; Savoie & Saunders 2015; Piñeiro-Corbeira *et al.* 2020b). *Melanothamnus ferulaceus* (Suhr ex J.Agardh) Díaz-Tapia & Maggs and *M. sphaerocarpus* (Børgesen) Díaz-Tapia & Maggs have been widely recorded in the Atlantic and Pacific Oceans, with the former also distributed in the Indian Ocean, while *M. gorgoniae* (Harvey) Díaz-Tapia & Maggs is predominantly known in the western Atlantic and has also been recorded in Cape Verde (Guiry & Guiry 2020). In addition to these five species, the recently described *M. testudinis* Serio, G.Furnari, I.Moro & K.Sciuto that lives on turtles in the Mediterranean is also presumed to be found in the Canary Islands (Serio *et al.* 2020). The diversity of species of *Melanothamnus* in Macaronesia has been characterized based on morphological studies (Rojas-González 1997; Neto *et al.* 2001; both as *Polysiphonia*), whereas surveys based on molecular data have not been performed.

In 2018, we conducted a diversity survey of the family Rhodomelaceae in the islands of Lanzarote (Canary Islands, Spain) and São Miguel (Azores, Portugal). The molecular characterization of samples using the *rbc*L gene led to the discovery of several species that differ from others molecularly characterized elsewhere and that morphologically do not conform to the species previously described in the study area. The objective of this work is to clarify the taxonomic identity of one of the discovered species analyzing its phylogenetic position and characterizing its morphology.

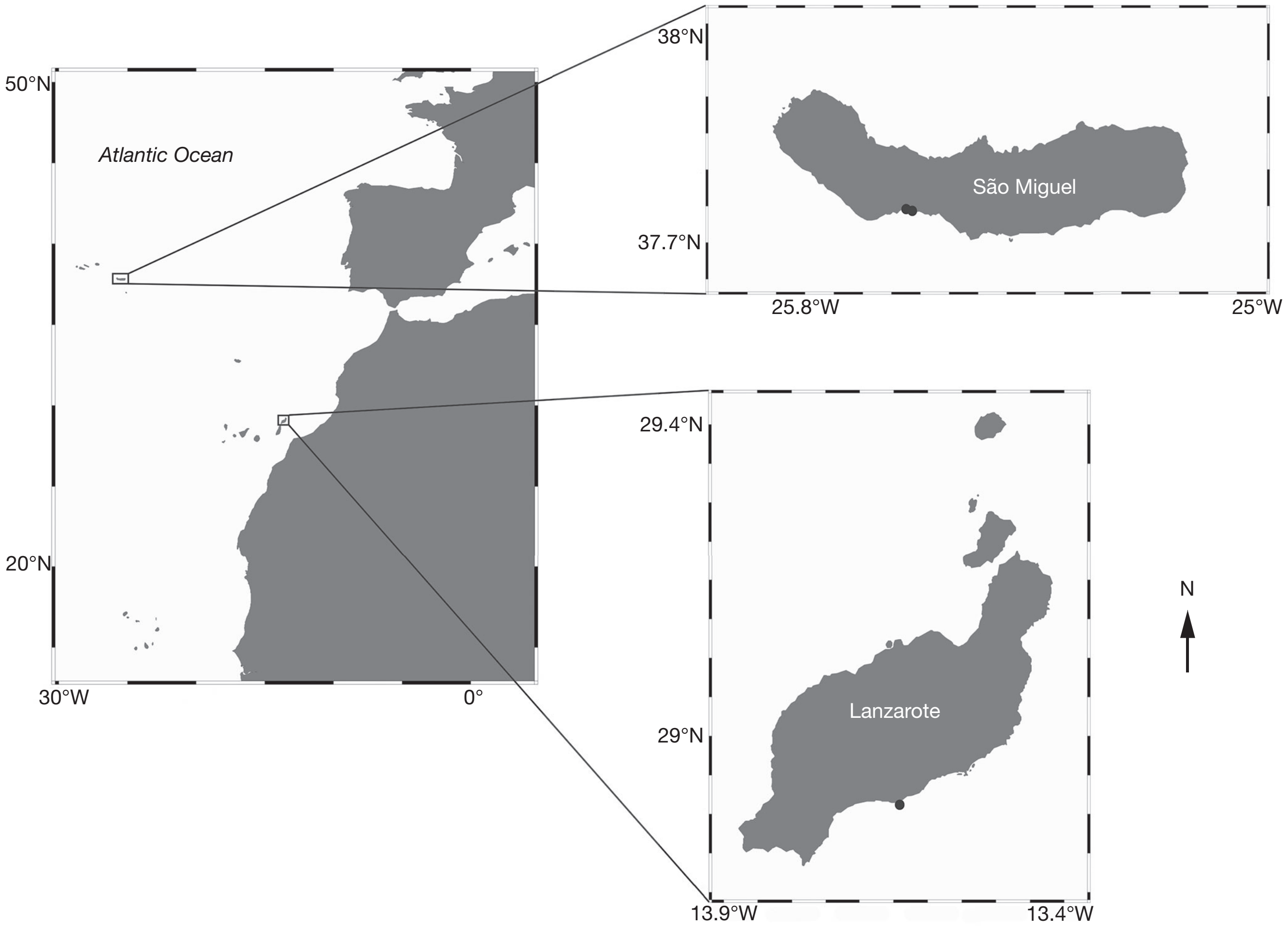

Fig. 1. — Distribution of *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. in Lanzarote (Canary Islands) and São Miguel (Azores).

MATERIAL AND METHODS

Material was collected in 2018 in the intertidal of São Miguel (Azores) and Lanzarote (Canary Islands) during diversity surveys of the family Rhodomelaceae (Fig. 1; Appendix 1). Specimens were carefully cleaned and isolated using a stereomicroscope. For each species and sample, part of the material was dried in silica gel desiccant for DNA extraction and the remaining material was preserved in 4% formalin seawater at 4ºC and stored in the dark for morphological studies. Some specimens were mounted in 20% Karo® Syrup solution (ACH Foods, Memphis, Tennessee, United States) or in a solution composed of 50% Karo, 1% aqueous aniline blue and 1% acetic acid. Sections for microscopic observations were made by hand using a razor blade. Pressed herbarium specimens were deposited at SANT (Herbarium of the University of Santiago de Compostela, Spain). Herbarium abbreviations follow Thiers (2021).

DNA was extracted from silica gel-dried material following an adapted cetyltrimethylammonium bromide (CTAB) protocol (Doyle & Doyle 1987). PCR amplification of the plastid *rbc*L gene was carried out using primers and conditions specified in Piñeiro-Corbeira *et al.* (2020a). The PCR products were purified and sequenced by Macrogen (Korea).

In order to establish the phylogenetic position of the studied species in the tribes Polysiphoniae and Streblocladieae, we constructed a matrix for the *rbc*L plastid gene including a sequence of each haplotype of the studied species along with 81 sequences belonging to other species of these tribes (Appendix 1, 2). Three sequences of *Symphyocladia* Falkenberg (Pterosiphoniae) were also added to the matrix as outgroups (Appendix 2) based on Díaz-Tapia *et al.* (2017a). All sequences were downloaded from GenBank except those belonging to the species under study and the South African sample of *M. incomptus* (Harvey) Díaz-Tapia & Maggs (MW567797).

Sequences were aligned using MAFFT (Katoh *et al.* 2019). We used Mr. Model test v.2.3.7 (Nylander 2004) in order to determine the evolutionary model that best fitted our data. Phylogenetic trees were obtained using Maximum Parsimony (MP), Maximum Likelihood (ML) and Bayesian Inference (BI) strategies, but only the ML tree is shown. MP and BI tests were conducted according to Torrecilla *et al.* (2003) and Pimentel *et al.* (2013), respectively. ML analyses were performed according to Díaz-Tapia *et al.* (2017b). Paup v.4.a165

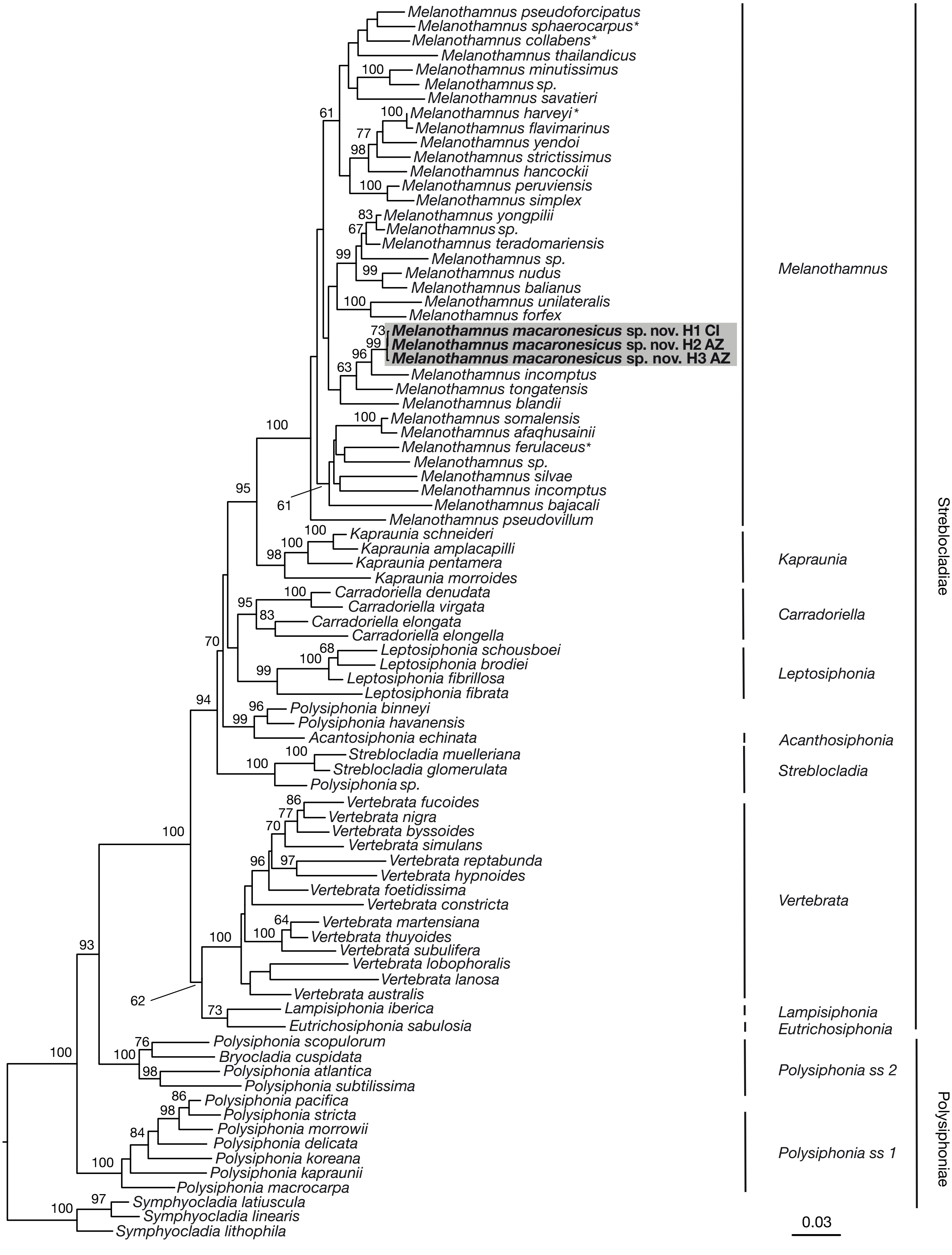

FIG. 2. — Phylogenetic tree estimated with ML analysis of *rbc*L sequences. Values at nodes indicate bootstrap support (only shown if >60). Species names shaded and printed in bold correspond to the new species, haplotype numbers (H1-H3 as in Appendix 1) and their distribution (AZ = Azores, CI = Canary Islands) are indicated. **Asterisks** indicate the species of *Melanothamnus* Bornet & Falkenberg that have been previously reported in Macaronesia.

(Swofford 2000), MrBayes 3.2.7a (Huelsenbeck & Ronquist 2001) and RAxML 8.1.X (Stamatakis 2014) were used for MP, BI and ML analyses, respectively. BI and ML tests were run in the *Cipres Science Gateway* server (https://www.phylo.org/portal2/home.action).

RESULTS

PHYLOGENY

The *rbc*L aligned matrix consisted of 1467 base pairs (length of new sequences 1183-1368 bp), of which 37.83% (555/1467) were variable. The GTR+I+G model was selected for all analyses. The phylogenetic analysis of the *rbc*L gene in the tribes Polysiphoniae and Streblocadieae placed the studied species in the tribe Streblocladieae with full support, together with the other *Melanothamnus* taxa (Fig. 2). The studied species was resolved as sister to *M. incomptus* (Harvey) Díaz-Tapia & Maggs from South Africa with high support (96%), although relationships with other members of *Melanothamnus* remained unresolved.

Eight *rbc*L sequences were newly obtained for the studied species, corresponding to three different haplotypes that were resolved in a fully supported clade. One haplotype was exclusively found in the Canary Islands, while the other two haplotypes were found only in the Azores (Fig. 2). Sequence divergence among haplotypes was up to 0.3% (3 base pairs). Sequence divergence between the studied species and the most closely related species (*M. incomputs*) was 3.3-3.4% (41-43 base pairs out of 1278). Thus, molecular analyses evidenced that the studied species differs from the other sequenced species in the genus, and *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. is described below.

MORPHOLOGICAL OBSERVATIONS

Family RHODOMELACEAE Horaninow
Genus *Melanothamnus* Bornet & Falkenberg

Melanothamnus macaronesicus
Rodríguez-Buján & Díaz-Tapia, sp. nov.
(Figs 3; 4)

DIAGNOSIS. — Thalli up to 2.5 cm in height, forming dense turfs composed of decumbent axes that produce extensive prostrate systems. Axes with four pericentral cells, ecorticate. Erect axes 130-200 µm in basal parts, with exogenous branches that replace trichoblasts, alternately or pseudodichotomously branched. Trichoblasts short, simple or once branched, formed on every segment. Spermatangial branches growing on the first dichotomy of fertile trichoblasts, with 1-2 apical sterile cells at maturity. Cystocarps globose. Fertile parts of tetrasporangial branches bifurcated or bearing alternate branches, with tetrasporangia forming markedly spiral series. *rbc*L sequence of the holotype: MW567802.

HOLOTYPE. — SANT 33663 (male and female gametophytes, tetrasporophytes).

ADDITIONAL STUDIED SPECIMENS. — PD4116 (sterile), PD4121 (tetrasporophytes), PD4129 (sterile), PD4130 (tetrasporophytes), Puerto del Carmen, Lanzarote, Canary Islands, Spain; PD3692 (sterile), Praia do Populo, São Miguel, Azores, Portugal; PD3843 (sterile), PD3847 (sterile), Praia San Roque, São Miguel, Azores, Portugal.

TYPE LOCALITY. — Puerto del Carmen, Lanzarote, Spain.

ETYMOLOGY. — "*macaronesicus*" refers to the name of the region where the species was found.

HABITAT AND DISTRIBUTION. — *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. was collected from turfs mixed with other small species in intertidal sand-covered rocks from the Azores and the Canary Islands.

VEGETATIVE MORPHOLOGY

Thalli up to 2.5 cm high, forming turfs of densely entangled axes. Thalli formed by numerous decumbent axes, forming extensive prostrate systems. Prostrate axes bear erect axes dorsally that branch alternately or pseudichotomously (Fig. 3A). Thallus brownish-red in colour, texture flaccid and delicate.

Axes ecorticate consisting of an axial cell surrounded by four pericentral cells (Fig. 3B). Pericentral cells with discoid plastids, lying exclusively on radial walls of pericentral cells (Fig. 3C), so outer walls appear transparent. Prostrate axes (130-) 150-340 µm in diameter, composed of segments Length/Diameter (L/D) 0.3-1.1 (-1.6). Rhizoids arising in the middle or in proximal parts of the pericentral cells, up to two per segment, cut off from the pericentral cells, unicellular, up to 1 mm in length and consisting of a filament 25-130 µm in diameter, occasionally branched and often terminated in digitate haptera (Fig. 3D). Prostrate axes bear erect axes dorsally at regular intervals and branch laterally forming further prostrate axes (Fig. 3E). Erect axes growing from obtuse apical cells of about 12.5 µm in diameter. Branches predominantly exogenous, replacing trichoblasts and formed every six segments, although larger or smaller distances are common (Fig. 3F). Adventitious branches occasional, growing from trichoblast scar cells. Basal segments in erect axes 130-200 µm in diameter; L/D 0.6-1.1. Segments in the middle part of the erect axes 80-120 µm in diameter, L/D 0.7-1.5.

Trichoblasts short, <260 µm in length with basal cells 7.5-10 (12.5) µm in diameter, simple or once branched. Trichoblasts formed on every segment, in a ¼ spiral pattern, deciduous and leaving conspicuous scar cells when shed (Fig. 3F, G).

REPRODUCTIVE MORPHOLOGY

Gametophytes dioecious. Spermatangial branches growing at the apices of erect axes on the first dichotomy of a trichoblast, one per segment in a ¼ spiral (Fig. 4A). Spermatangial axes cylindrical, 90-190 µm in length and 25-40 µm in diameter, with 1-2 apical sterile cells at maturity (Fig. 4B).

Cystocarps formed at the apices of erect axes, globose, up to 550 µm in height and diameter, cells around the ostiole are slightly larger than cells of the pericarp immediately below (Fig. 4C, D).

Tetrasporangia developing at the apices of alternate branches whose fertile parts are bifurcated or alternately branched

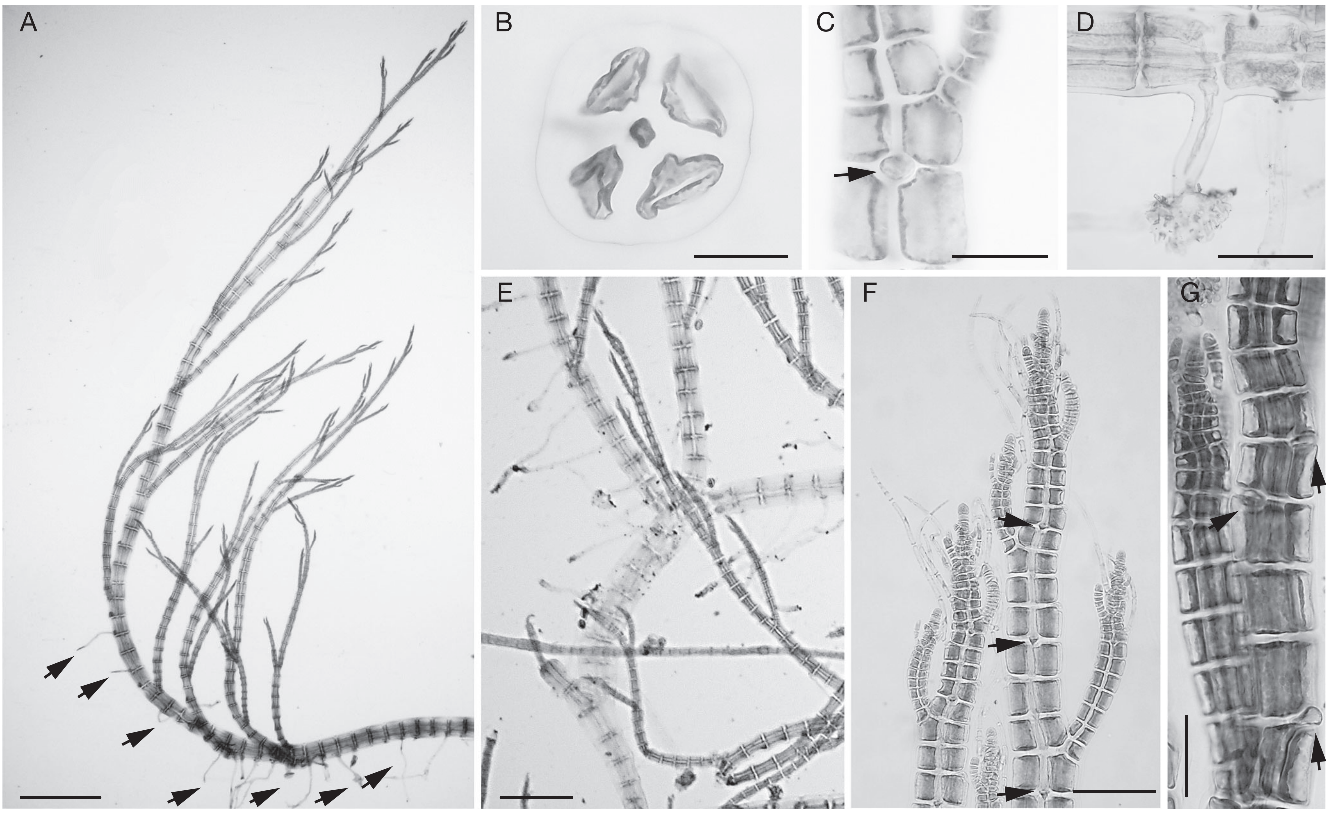

Fig. 3. — *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov.: vegetative morphology: **A**, habit, prostrate axis with many rhizoids (**arrows**) and erect axes alternately branched; **B**, cross section with a small axial cell and four pericentral cells; **C**, surface view of pericentral cells with plastids lying only on radial walls, as well as a scar cell of a trichoblast (**arrow**); **D**, rhizoid cut off from pericentral cell; **E**, prostrate axes branched laterally; **F**, apices of erect axes with trichoblasts, alternately branched every 5-6 segments and showing scar cells of trichoblasts (**arrows**); **G**, erect axis showing the spiral arrangement of the scar cells of trichoblasts (**arrows**). A, E, G correspond to the holotype (PD4111); B (PD4116); C (PD4121); D, F (PD4129). Scale bars: A, 1 mm; B, C, G, 50 µm; D, 200 µm; E, 500 µm; F, 100 µm.

(Fig. 4E, F). Tetrasporangia forming markedly spiral series, subspherical, 37.5-67.5 µm in diameter, tetrahedrally divided (Fig. 4F, G).

DISCUSSION

In this work the new species *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. is described based on both molecular and morphological evidence. The new species was collected in two Macaronesian archipelagos (the Azores and the Canary Islands), growing in intertidal algal turfs mixed with other turf-forming species.

Our phylogenetic analyses evidenced that *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. is placed with full support in the genus *Melanothamnus* of the tribe Streblocladieae. Morphological observations support this placement, as *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. has unicellular rhizoids cut off from the pericentral cells, a character distinctive of the tribe (Díaz-Tapia *et al.* 2017a). Moreover, plastids are arranged lying only on radial walls of pericentral cells, a synapomorphic character of *Melanothamnus* (Díaz-Tapia *et al.* 2017b). However, the uniformity of this character in *Melanothamnus* has been recently discussed (Huisman 2018; Serio *et al.* 2020). Three Australian species with plastids lying on all walls of pericentral cells were included tentatively in *Melanothamnus* (Huisman 2018). Similarly, this character was described in Australian specimens identified based on morphology as *M. tongatensis* (Harvey *ex* Kützing) Díaz-Tapia & Maggs and *M. nudus* (Mamoozadeh & Freshwater) Freshwater, whose type localities are in Tonga and the Caribbean, respectively (Huisman 2018). Thus, further studies using molecular data are needed to test whether these Australian species or specimens actually belong to the genus *Melanothamnus* or if this character can exhibit some variability in the genus. Moreover, the recently described species *M. testudinis* has pericentral cells with plastids arranged either on all or only on radial walls (Serio *et al.* 2020). Our study of *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. shows that this character can be easily observed in most formalin preserved specimens, but it can occasionally not be adequately studied in some specimens or some parts of them depending on the preservation conditions of plastids. The other synapomorphic character of *Melanoth-*

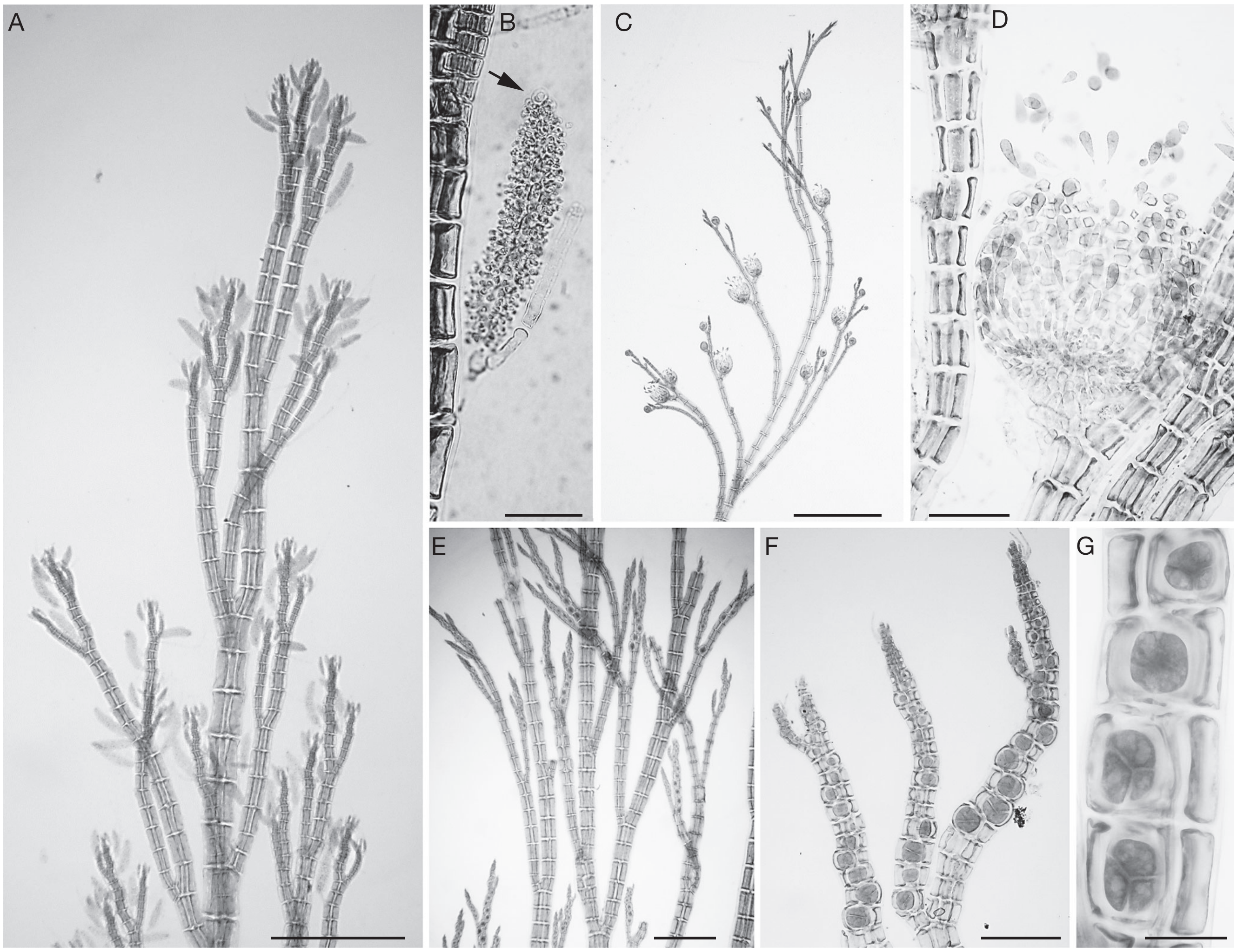

Fig. 4. — *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov.: reproductive morphology: **A**, erect axis with spermatangial branches; **B**, mature spermatangial branch with a sterile apical cell (**arrow**); **C**, erect axis with cystocarps; **D**, cystocarp and carpospores; **E**, tetrasporophyte; **F**, tetrasporangia arranged in spiral series; **G**, detail of tetrasporangia. A-E, G correspond to the holotype (PD4111); F (PD3843). Scale bars: A, 400 µm; B, G, 50 µm; C, 1 mm; D, F, 200 µm; E, 500 µm.

amnus, having 3-celled carpogonial branches (Díaz-Tapia *et al.* 2017b), could not be observed in *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. Other relevant characters that are common in *Melanothamnus* and that were present in the new species are the spiral arrangement of tetrasporangia, the development of spermatangial branches on the first dichotomy of trichoblasts and the formation of trichoblasts or branches on successive segments (Kim & Lee 1999, as *Neosiphonia*; Díaz-Tapia *et al.* 2017b).

Melanothamnus macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov. differs from other sequenced congeners by *rbc*L sequence divergence ≥3.3%, supporting its recognition as a new species. Moreover, the new species can be morphologically distinguished from other species by its unique combination of the characters habit, number of pericentral cells, cortication, trichoblasts and number of apical sterile cells in spermatangial branches (Table 1). Molecular and/or morphological distinction of the new species regarding the other species of the genus includes the five formerly reported species in Macaronesia (Fig. 2; Table 1). As most species of *Melanothamnus*, the new species has four pericentral cells, differing from the 12 species that have a higher number such as *M. forfex* (Harvey) Díaz-Tapia & Maggs or *M. collabens* (Womersley 1979, as *Polysiphonia*; Díaz-Tapia & Bárbara 2013, as *Streblocladia*). This trait has a high diagnostic value for distinguishing species in the Polysiphonieae and Streblocladieae (Stuercke & Freshwater 2008, as *Polysiphonia sensu lato*) and, therefore, we restricted our comparisons of other morphological characters to the new species and the other *Melanothamnus* spp. that have four pericentral cells.

Melanothamnus macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov. differs morphologically from most *Melanothamnus* spp. by its decumbent habit with an extensive system of profusely branched prostrate axes. Only 13 species of the genus have a similar decumbent habit, which contrasts with most species that are erect or have short prostrate axes (Table 1). Another character that distinguishes *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. from most congeners

Table 1. — Comparison of selected morphological characters for species currently assigned to *Melanothamnus* Bornet & Falkenberg that have four pericentral cells.

Species	Type locality	Habit and length (cm)	Cortication	Trichoblasts: Arrangement, maximum length (µm) and number of times branched	Apical sterile cells in spermatangial branches	Diameter (µm) of erect axes	References
M. macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov.	Canary Islands, Spain	Decumbent, < 2.5	–	On every segment. 220. Simple or once branched	1-2	Base: 130-200 Middle: 80-120	This work
M. afaqhussainii Shameel	Pakistan	Erect	+	Absent (old apices). Several segments apart (young apices)	–	<4000	Shameel (1999); Afaq-Husain & Shameel (2000)
M. apiculatus (Hollenberg) Díaz- Tapia & Maggs	Hawaii, United States	Erect	–	On every segment. 740. 3-4 times branched	1	150-250 (-320)	Hollenberg (1968); Kim & Abbott (2006)
M. bajacali (Hollenberg) Díaz-Tapia & Maggs	Baja California, Mexico	Erect	Light in some old apices	On every segment. 750. Branched many times	0	75-150	Hollenberg (1961); Mamoozadeh & Freshwater (2011)
M. blandii (Harvey) Díaz-Tapia & Maggs	Victoria, Australia	Decumbent	–	On every segment. 1-3 times branched	(1-) 2-3	300-550	Womersley (1979)
M.cheloniae (Hollenberg & J.N.Norris) Díaz-Tapia & Maggs	Gulf of California, Mexico	Erect	–	On every segment. 400. 1-3 times branched	0	300	Hollenberg & Norris (1977); Norris (2014)
M.decumbens (T.Segi) Díaz-Tapia & Maggs	Japan	Erect	+	On every segment. 1-3 times branched	1-2	Base: 600-1000 Middle: 300-600	Segi (1951); Kim (2003)
M. delicatulus (Hollenberg) Huisman	Hawaii, United States	Decumbent	–	On every segment. 230. 2-4 times branched	–	Middle: 25-30	Hollenberg (1968)
M. eastwoodiae (Setchell & N.L.Gardner) Díaz-Tapia & Maggs	Baja California, Mexico	Erect, 5-12	–	On every segment. Once branched	–	Base: 300-400	Norris (2014)
M. ecorticatus (R.E.Norris) Díaz-Tapia & Maggs	Hawaii, United States	Erect, <2	–	On every segment. Branched many times	>1	<2000	Norris (1994)
M. ferulaceus (Suhr ex J.Agardh) Díaz-Tapia & Maggs	East coast of Mexico; North America; Guadeloupe; Australia; Marquesas Islands; Hawaiian Islands.	Erect, <4 (-15)	–	On every segment. 90 µm. Branched many times	1-2	(150-) 250-350	Mamoozadeh & Freshwater (2012)
M. flavimarinus (M. S.Kim & I.K.Lee) Díaz-Tapia & Maggs	Korea	Erect, 4-5	–	On every segment. 150. 1-2 times branched	1-2	Base: 85-170 Middle: 100-130	Kim & Lee (1999)
M. gigas Huisman	Western Australia	Erect, 40	+	On every segment	Several		Huisman (2018)
M. gorgoniae (Harvey) Díaz-Tapia & Maggs	Florida, United States	Erect	–	Scarce. On every segment	1	Base: 160-270 Middle: 130-230	Kapraun (1979); Guimarães *et al.* (2004);
M. hancockii (E.Y.Dawson) Díaz-Tapia & Maggs	Baja California, Mexico	Erect, <2	+	On every segment. Branched	–	Base: <1000	Dawson (1944); Norris (1994)
M. harlandii (Harvey) Díaz-Tapia & Maggs	Hong Kong, China	Erect, 4-8	+	On every segment. 700. 3-4 times branched	1-2	Base: 800-1000 Middle: 500-800	Yoon (1986); Kim (2003)
M. harveyi (Bailey) Díaz-Tapia & Maggs	Connecticut, United States	Erect	+	On every segment	1-2	400-500	Maggs & Hommersand (1993); Kapraun (1977)
M. hawaiiensis (Hollenberg) Díaz-Tapia & Maggs	Hawaii, United States	Erect	–	On every segment. 500. Branched many times	1	300-500	Hollenberg (1968); Kim & Abbott (2006)

TABLE 1. — Continuation

Species	**Type locality**	**Habit and length (cm)**	**Cortication**	**Trichoblasts: Arrangement, maximum length (µm) and number of times branched**	**Apical sterile cells in spermatangial branches**	**Diameter (µm) of erect axes**	**References**
M. incomptus (Harvey) Díaz-Tapia & Maggs	South Africa	Decumbent, 2-3 (-6)	–	On every segment. Simple or once branched	0	<400	Anderson *et al.* (2016)
M. infestans (Harvey) Huisman	Western Australia	Erect, 16	–	On every segment	0-1	-	Huisman (2018)
M. japonicus (Harvey) Díaz-Tapia & Maggs	Japan	Erect, 1-20	+	On every segment. Once or more branched	1	700-800	Segi (1951); Kim (2003)
M. masonii (Setchell & N.L.Gardner) Díaz-Tapia & Maggs	Baja California, Mexico	Erect, 2-3	–	On every segment. 480. 2-3 times branched	–	350-400	Hollenberg & Norris (1977)
M. minutissimus (Hollenberg) Díaz-Tapia & Maggs	Baja California, Mexico	Erect, <0.3	–	On every segment. 80	0	<145	Hollenberg (1942)
M. nanus (A.J.K.Millar) Díaz-Tapia & Maggs	New South Wales, Australia	Erect, <1	+	On every segment. 26	2	Base: <400 Middle: <180	Millar (1990)
M. nudus (N.R.Mamoozadeh & D.W.Freshwater) D.W.Freshwater	Panama	<0.7	–	Absent	–	70-140	Mamoozadeh & Freshwater (2012)
M. platycarpus(Børgesen) Díaz-Tapia & Maggs	India	Decumbent	–	On every segments. Branched many times	–	70-80	Børgesen (1934)
M. pseudoforcipatus Díaz-Tapia	Galicia, Spain	Erect	–	Scarce irregularly	–	Base: 170-190 (-220)	Díaz-Tapia *et al.* (2017b)
M. pseudovillum (Hollenberg) Díaz-Tapia & Maggs	Johnson Islands	Decumbent, 0.1-0.27	–	Most segments. 1000. 4 times branched	–	40-60	Hollenberg (1968)
M. quadratus (Hollenberg) Huisman	Gilbert Islands	Decumbent, 0.8	–	Irregular intervals of 4-8. 2-3 times branched	–	100-160	Hollenberg (1968)
M. ramireziae (D.E.Bustamante, B.Y.Won & T.O.Cho) Díaz-Tapia & Maggs	Peru	Erect, 2.4-5	–	On every segment. 31. Simple or once branched	–	86-103	Bustamante *et al.* (2013a)
M. savatieri (Hariot) Díaz-Tapia & Maggs	Japan	Erect, 0.5-1	+	On every segment. Twice or more branched	1-2	100-200	Segi (1951); Kim (2005)
M. silvae (D.E.Bustamante, B.Y.Won & T.O.Cho) Díaz-Tapia & Maggs	Bali, Indonesia	Decumbent, 1.0-2.9	–	On every segment. 125. 1-2 times branched	–	61-73	Bustamante *et al.* (2013b)
M. simplex (Hollenberg) Díaz-Tapia & Maggs	California, United States	Decumbent	–	On every segment. 1-3 times branched	0	160-250	Hollenberg (1942)
M. somalensis Bornet & Falkenberg	Somalia	Erect, <36	+	Several segments apart	–	–	Kylin (1956); Wynne & Banaimoon (1990)
M. sparsus (Setchell) Díaz-Tapia & Maggs	Tahiti	Prostrate, < 1	–	On every segment. 650. 3-5 times branched	0	–	Hollenberg (1968)
M. sphaerocarpus (Børgesen) Díaz-Tapia & Maggs	Virgin Islands	Erect	–	On every segment. 875. Many times branched	0-1	100-180	Hollenberg (1968)
M. strictissimus (J.D.Hooker &Harvey) Díaz-Tapia &Maggs	New Zealand	Decumbent, (1)2-12(15)	+	On every segment. Branched many times.	1-2	500-1000	Adams (1991)
M. testudinis Serio, G.Furnari, I.Moro, K. Sciuto	Lampedusa, Italy	Decumbent, 2-3	–	On every segment. 500. 1-2 times branched	–	100–140	Serio *et al.* (2020)
M. thailandicus (N.Muangmai & C.Kaewsuralikhit)	Thailand	Erect, 5-15	–	Scarce. Associated with reproductive structure. 100. 2-3 times branched	1	100-500	Muangmai *et al.* (2014)
M. tongatensis (Harvey ex Kützing) Díaz-Tapia & Maggs	Panama	Erect, 1.5-3(8)	–	On every segment. 175. Branched many times	0-1	50-150	Mamoozadeh & Freshwater (2012)

Table 1. — Continuation

Species	Type locality	Habit and length (cm)	Cortication	Trichoblasts: Arrangement, maximum length (µm) and number of times branched	Apical sterile cells in spermatangial branches	Diameter (µm) of erect axes	References
M. unilateralis (Levring) Díaz-Tapia & Maggs	Juan Fernández Islands, Chile	Erect	+	On every segment	–	750-1250 (-1500)	Levring (1941); Díaz-Tapia *et al.* (2017a)
M. upolensis (Grunow) Díaz-Tapia & Maggs	Samoa	Decumbent, 1-2-(3)	–	Every 2 or 3 segments. 340-(700). 1-3(4) times branched	1-2	100-120	Hollenberg (1968)
M. yendoi (T.Segi) Díaz-Tapia & Maggs	Japan	Decumbent, 1.5-4	–	On every segment. 200-300. 2-3 times branched	1	Base: 190-300 Middle: 100-140	Segi (1951); Yoon (1986)
M. yongpilii (Kim & Kim) Díaz-Tapia &Maggs	Korea	Erect, 5-12	–	On every segment. 420. 1-3 times branched	2-3	180-340	Kim & Kim (2016)

and that has been uniformly observed in all studied specimens is that trichoblasts are short (<260 µm) and unbranched or branched only once. The only species with similar trichoblasts are *M. incomptus* and *M. ramireziae* (D.E.Bustamante, B.Y. Won & T.O.Cho) Díaz-Tapia & Maggs (Bustamante *et al.* 2012; Anderson *et al.* 2016), while trichoblasts are more profusely branched in other species.

Melanothamnus incomptus is the only currently recognized species that shares most of the diagnostic characters with *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. (decumbent, four pericentral cells, ecorticate, short trichoblasts). Interestingly, both species have been resolved as sister with high support in our phylogeny. Despite morphological similarities, they clearly constitute different molecular entities, as their divergence in the *rbc*L gene was 3.3-3.4%. It is worth mentioning that two sequences assigned to *M. incomptus* with divergent phylogenetic affinities were included in our phylogeny, suggesting the existence of cryptic diversity in this South African species. Regardless of which of the two sequences corresponds to the genuine *M. incomptus*, our phylogeny evidenced that both entities clearly differ from *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov.

In addition to the molecular divergence between *M. incomptus* and *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov., they differ from each other in the number of sterile cells in spermatangial branches (0 *vs* 1-2, respectively). However, even if this trait has been often used for species delineation, its reliability has been questioned as it can be variable in some species as well as depending on the maturity of spermatangial branches (Kim & Lee 1999; Stuercke & Freshwater 2008; Díaz-Tapia *et al.* 2021). Moreover, *M. incomptus* is larger in size than *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. as indicated by both thallus height (up to 6 *vs* up to 2.5 cm) and diameter of the prostrate and erect axes (up to 400 *vs* 150-340 µm; 200-240 µm *vs* 80-120 µm) (Rull Lluch 2002; Anderson *et al.* 2016). Furthermore, *M. incomptus* may present a greater number of pericentral cells in some prostrate axes (6), a character never observed in *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. However, this character was only observed in a North Namibian population (Rull Lluch 2002) and it might be absent in the South African populations from which we obtained the sequences included in our phylogeny.

The current known distribution of *Melanothamnus macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. and our previous work on the Strebocladieae suggest that this species could be endemic to Macaronesia. Extensive surveys of the Streblocladieae in the Atlantic Iberian Peninsula and the Mediterranean that included the sequencing of more than 250 specimens (PD, pers. obs.) failed to detect this taxon. Likewise, the new species was not found in molecular diversity surveys of this group in Central American coasts (Stuerke & Freshwater 2008, 2010; Mamoozadeh & Freshwater 2011, 2012), even if this region and Macaronesia often share the occurrence of species (Haroun & Prud'homme van Reine 1993; Machín-Sánchez *et al.* 2018). While we cannot rule out that the new species could have remained unnoticed in these or other undersampled regions (e.g. northern Africa), endemicity would not be surprising. The Macaronesian archipelagos, of recent volcanic origin, host a high diversity of endemic animals and plants, which contrasts the low number (19) of endemic macroalgae (Freitas *et al.* 2019). Our finding suggests that further biodiversity studies of seaweeds using molecular data could reveal a higher number of endemisms than previously thought; particularly in algal turfs, the most common type of algal assemblage in Macaronesia (Tuya & Haroun 2006; Wallenstein *et al.* 2009) whose diversity has been barely studied using molecular tools (but see Díaz-Tapia *et al.* 2021). Turfs are composed by small species with a similar habit including prostrate and erect axes, and species identification often requires the observation of microscopic characters (Price & Scott 1992; Díaz-Tapia & Bárbara 2013, 2014). These traits render turf-forming species easy to overlook, as probably has occurred with *M. macaronesicus* Rodríguez-Buján & Díaz-Tapia, sp. nov. Our work provides further evidence that the species diversity in algal turfs has been largely underestimated and more effort is yet required in order to improve our understanding of these complex assemblages.

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APPENDICES

Appendix 1. — Materials collected during this study, including collection information and GenBank accession numbers.

Species	**Haplotype (Fig. 2)**	**Collection information and herbarium vouchers for studied specimens**	**GenBank accession number**
Melanothamnus macaronesicus Rodríguez-Buján & Díaz-Tapia, sp. nov.	H1	Puerto del Carmen, Lanzarote, Canary Islands; 11.VI.2018; SANT 33663; PD4111; 28°55’10”N, 13°39’47”W	MW567802
		Puerto del Carmen, Lanzarote, Canary Islands; 11.VI.2018; PD4116; 28°55’10”N, 13°39’47”W	MW567803
		Puerto del Carmen, Lanzarote, Canary Islands; 11.VI.2018; SANT 33664; PD4121; 28°55’10”N, 13°39’47”W	MW567804
		Puerto del Carmen, Lanzarote, Canary Islands; 11.VI.2018; SANT 33665; PD4129; 28°55’10”N, 13°39’47”W	MW567805
		Puerto del Carmen, Lanzarote, Canary Islands; 11.VI.2018; SANT 33666; PD4130; 28°55’10”N, 13°39’47”W	MW567801
	H2	Praia do Populo, São Miguel, Azores; 12.VI.2018; SANT 33649; PD3692; 37°45’00”N, 25°37’05”W	MW567800
	H3	Praia San Roque, São Miguel, Azores; 15.VI.2018; SANT 33656; PD3843; 37°45’00”N, 25°37’05”W	MW567798
		Praia San Roque, São Miguel, Azores; 15.VI.2018; SANT 33657; PD3847; 37°45’00”N, 25°37’05”W	MW567799

Appendix 2. — Sample information for the species included in the phylogenetic analysis.

Species	**Publication**	**GenBank accession number**
Acanthosiphonia echinata (Harvey) Savoie & G.W.Saunders	Mamoozadeh & Freshwater (2011), as *Polysiphonia*	HM573559
Bryocladia cuspidata (J.Agardh) De Toni	Lin *et al.* (2001)	AF259498
Carradoriella denudata (Dillwyn) Savoie & G.W.Saunders	Bárbara *et al.* (2013), as *Polysiphonia*	JX828147
Carradoriella elongata (Hudson) Savoie & G.W.Saunders	Bárbara *et al.* (2013), as *Polysiphonia*	JX828162
Carradoriella elongella (Harvey) Savoie & G.W.Saunders	McIvor *et al.* (2001), as *Polysiphonia*	AF342913
Carradoriella virgata (C. Agardh) P.C.Silva	Bárbara *et al.* (2013), as *Polysiphonia*	JX828152
Eutrichosiphonia sabulosia (B.Kim & M.S.Kim) Savoie & G.W.Saunders	Kim & Kim (2014), as *Polysiphonia*	KF479250
Kapraunia amplacapilli (B.Kim & M.S.Kim) Savoie & G.W.Saunders	Kim & Kim (2014), as *Polysiphonia*	KF479253
Kapraunia morroides (B.Kim & M.S.Kim) Savoie & G.W.Saunders	Kim & Kim (2014), as *Polysiphonia*	KF479257
Kapraunia pentamera (Hollenberg) Savoie & G.W.Saunders	Mamoozadeh & Freshwater (2011), as *Polysiphonia*	HM573564
Kapraunia schneideri (B.Stuercke & D.W.Freshwater) Savoie & G.W.Saunders	Stuercke & Freshwater (2010), as *Polysiphonia*	GU385836
Lampisiphonia iberica Bárbara, Secilla, Díaz Tapia & H.-G. Choi	Bárbara *et al.* (2013)	JX828131
Leptosiphonia brodiei (Dillwyn) Savoie & G.W.Saunders	McIvor *et al.* (2001), as *Polysiphonia*	AF342916
Leptosiphonia fibrata (Dillwyn) Savoie & G.W.Saunders	McIvor *et al.* (2001), as *Polysiphonia*	AF342915
Leptosiphonia fibrillosa (Dillwyn) Savoie & G.W.Saunders	McIvor *et al.* (2001), as *Polysiphonia*	AF342912
Leptosiphonia schousboei (Thuret) Kylin	Bárbara *et al.* (2013)	JX828133
Melanothamnus afaqhusainii Bornet & Falkenberg	Savoie & Saunders (2016)	KU564460
Melanothamnus bajacali (Hollenberg) Díaz-Tapia & Maggs	Mamoozadeh & Freshwater (2011), as *Neosiphonia*	HM573572
Melanothamnus balianus (D.E.Bustamante, B.Y.Won & T.O.Cho) Díaz-Tapia & Maggs	Bustamante *et al.* (2013b), as *Neosiphonia*	KF146879
Melanothamnus blandii (Harvey) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499556
Melanothamnus collabens (C.Agardh) Díaz-Tapia & Maggs	Bárbara *et al.* (2013), as *Streblocladia*	JX828157
Melanothamnus ferulaceus (Suhr ex J.Agardh) Díaz-Tapia & Maggs	Mamoozadeh & Freshwater (2011), as *Neosiphonia*	HM573584
Melanothamnus flavimarinus (M.-S.Kim & I.K.Lee) Díaz-Tapia & Maggs	Kim & Yang (2006), as *Neosiphonia*	DQ787481
Melanothamnus forfex (Harvey) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499565
Melanothamnus hancockii (E.Y.Dawson) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499548
Melanothamnus harveyi (J. Bailey) Díaz-Tapia & Maggs	Bárbara *et al.* (2013), as *Polysiphonia*	JX828134
Melanothamnus incomptus (Harvey) Díaz-Tapia & Maggs	This study, collected in Knysna, Western Cape, South Africa by J. Costa and K. Dixon in December 2014	MW567797
Melanothamnus cf. *minutissimus* (Hollenberg) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499557
Melanothamnus nudus (Mamoozadeh & Freshwater) Freshwater	Mamoozadeh & Freshwater (2012), as *Polysiphonia*	HM573571
Melanothamnus peruviensis (D.E.Bustamante, B.Y.Won, M.E.Ramirez & T.O.Cho) Díaz-Tapia & Maggs	Bustamante *et al.* (2012), as Neosiphonia	JN989969
Melanothamnus pseudoforcipatus Díaz-Tapia	Díaz-Tapia *et al.* (2017b)	KY620089
Melanothamnus pseudovillum (Hollenberg) Díaz-Tapia & Maggs	Mamoozadeh & Freshwater (2011), as *Polysiphonia*	HM573568
Melanothamnus savatieri (Hariot) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499558
Melanothamnus silvae (D.E.Bustamante, B.Y.Won & T.O.Cho) Díaz-Tapia & Maggs	Bustamante *et al.* (2013b), as *Neosiphonia*	KF146878

Appendix 2. — Continuation.

Species	Publication	GenBank accession number
Melanothamnus simplex (Hollenberg) Díaz-Tapia & Maggs	McIvor *et al.* (2001), as *Polysiphonia*	AF342909
Melanothamnus somalensis Bornet & Falkenberg	Díaz-Tapia *et al.* (2017a)	KX499555
Melanothamnus sp.	Carlile (2009), as *Polysiphonia*	GQ252567
Melanothamnus sp.	Mamoozadeh & Freshwater (2011), as *Neosiphonia*	HM573573
Melanothamnus sp.	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499561
Melanothamnus sp.	Díaz-Tapia *et al.* (2017a), as *Polysiphonia*	KX499562
Melanothamnus sphaerocarpus (Børgesen) Díaz-Tapia & Maggs	Mamoozadeh & Freshwater (2011), as *Neosiphonia*	HM573569
Melanothamnus strictissimus (J.D.Hooker & Harvey) Díaz-Tapia & Maggs	Stuercke & Freshwater (2010), as *Polysiphonia*	GU385833
Melanothamnus teradomariensis (M.Noda) Díaz-Tapia & Maggs	Bárbara *et al.* (2013), as *Neosiphonia*	JX828136
Melanothamnus thailandicus (N.Muangmai & C.Kaewsuralikhit) Díaz-Tapia & Maggs	Muangmai *et al.* (2014), as *Neosiphonia*	KM502785
Melanothamnus tongatensis (Harvey ex Kützing) Díaz-Tapia & Maggs	Mamoozadeh & Freshwater (2011), as *Neosiphonia*	HM573570
Melanothamnus unilateralis (Levring) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a), as *Fernandosiphonia*	KX499549
Melanothamnus yendoi (Segi) Díaz-Tapia & Maggs	Bárbara *et al.* (2013), as *Neosiphonia*	JX828137
Melanothamnus yongpilii (B.Kim & M.-S.Kim) Díaz-Tapia & Maggs	Kim & Kim (2014), as *Polysiphonia*	KT964456
Polysiphonia atlantica Kapraun & J.N. Norris	Bárbara *et al.* (2013)	JX828141
Polysiphonia binneyi Harvey	Mamoozadeh & Freshwater (2011)	HM573554
Polysiphonia delicata Díaz-Tapia	Díaz-Tapia *et al.* (2017b)	KY620062
Polysiphonia havanensis Montagne	Mamoozadeh & Freshwater (2011)	HM573554
Polysiphonia kapraunii B.Stuercke & D.W.Freshwater	Stuercke & Freshwater (2008)	EU492920
Polysiphonia koreana D.Bustamante, B.Y.Won & T.O.Cho	Bustamante *et al.* (2015)	KJ957811
Polysiphonia macrocarpa (C.Agardh) Sprengel	Mamoozadeh & Freshwater (2011)	HM573545
Polysiphonia morrowii Harvey	D'Archino *et al.* (2013)	KC152488
Polysiphonia pacifica Hollenberg	Kim *et al.* (2005)	AY958162
Polysiphonia scopulorum Harvey	Bárbara *et al.* (2013), as *P. caespitosa*	JX828149
Polysiphonia sp.	Mamoozadeh & Freshwater (2011, as *P. pernacola*)	HM573576
Polysiphonia stricta (Dillwyn) Greville	Bárbara *et al.* (2013)	JX828151
Polysiphonia subtilissima Montagne	Lam *et al.* (2013)	JX294918
Streblocladia glomerulata (Montagne) Papenfuss	Díaz-Tapia *et al.* (2017a)	KX499569
Streblocladia muelleriana J.Agardh	Fujii *et al.* (2006), as *Polysiphonia*	AY588412
Symphyocladia latiuscula (Harvey) Yamada	Kim *et al.* (2010)	GQ867072
Symphyocladia linearis (Okamura) Falkenberg	Bárbara *et al.* (2013)	JX828158
Symphyocladia lithophila M.-S.Kim	Kim *et al.* (2010)	GQ867078
Vertebrata australis (C.Agardh) Kuntze	Díaz-Tapia *et al.* (2017a)	KX499546
Vertebrata byssoides (Goodenough & Woodward) Kuntze	Yang *et al.* (2016), as *Brongniartella*	DQ787584
Vertebrata constricta (Womersley) Díaz-Tapia & Maggs	Stuercke & Freshwater (2010), as *Polysiphonia*	GU385832
Vertebrata foetidissima (Cocks ex Bornet) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2013), as *Polysiphonia*	JQ653284
Vertebrata fucoides (Hudson) Kuntze	Bárbara *et al.* (2013), as *Polysiphonia*	JX828163
Vertebrata hypnoides (Welwitsch ex J.Agardh) Kuntze	Díaz-Tapia *et al.* (2017a)	KX499547
Vertebrata lanosa (Linneaeus) T. Christensen	Stuercke & Freshwater (2008)	EU492914
Vertebrata lobophoralis (N.R.Mamoozadeh & D.W.Freshwater) D.W.Freshwater	Mamoozadeh & Freshwater (2011), as *Polysiphonia*	HM573551
Vertebrata martensiana (Kützing) Piñeiro-Corbeira, Maggs & Díaz-Tapia	Bárbara *et al.* (2013), as *Boergeseniella fruticulosa*	JX828161
Vertebrata nigra (Hudson) Díaz-Tapia & Maggs	Bárbara *et al.* (2013), as *Polysiphonia*	JX828164
Vertebrata reptabunda (Suhr) Díaz-Tapia & Maggs	Díaz-Tapia *et al.* (2017a)	KX499554
Vertebrata simulans (Harvey) Kuntze	Díaz-Tapia *et al.* (2017a)	KX499568
Vertebrata subulifera (C.Agardh) Kuntze	Díaz-Tapia *et al.* (2017a)	KX499564
Vertebrata thuyoides (Harvey) Kuntze	Bárbara *et al.* (2013), as *Polysiphonia*	JX828125