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Pterocladiella maribagoensis (Gelidiales, Rhodophyta), a new marine alga from Cebu, Philippines

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Abstract

A new species of marine gelidioid red algae, *Pterocladiella maribagoensis*, is described and illustrated. *Pterocladiella maribagoensis* is distinguished by small, terete to compressed thalli with alternate or irregular branches, peg-like haptera, rhizines in medulla, and tetrasporangial sori without sterile margin at the terminal of branches. Analyses of both mitochondrial *cox*1 and plastid *rbc*L sequences revealed that *P. maribagoensis* was distinct from other species of *Pterocladiella* and clustered with *P. australafricanensis*, *P. beachiae*, *P. caerulescens*, *P. phangiae*, and *P. psammophila*. Morphological differences between *P. maribagoensis* and similar species are presented.

Key words: *cox*1, Pterocladiaceae, morphology, *rbc*L, Southeast Asia, taxonomy

Introduction

Pterocladiella Santelices & Hommersand (1997: 117) is a gelidioid marine algal genus that is widely distributed from tropical to cold temperate waters in the world (Santelices 1998, Shimada *et al.* 2000, Tronchin & Freshwater 2007, Freshwater *et al*. 2010, Sohrabipour *et al*. 2013, Guiry & Guiry 2016). This genus is economically important for the production of agar and agarose (as *Pterocladia*, Felicini & Perrone 1994). *Pterocladiella* was established to accommodate four species previously known as *Pterocladia* J. Agardh (1851: 482) with the generitype, *P. capillacea* (S.G. Gmelin) Santelices & Hommersand (1997: 118). *Pterocladiella* was originally segregated from *Pterocladia* by female plants in which cystocarps have single locules with ovoid or triangular-shaped cavity and chains of carposporangia radiating from a core of gonimoblast filaments surrounding the central axis (Santelices & Hommersand 1997). Thalli are also composed of entangled stolons and erect axes, attached to substratum by peg-like haptera, pinnate or irregular branches, rhizines mostly in medullar. Tetrasporangia are arranged regularly or irregularly on sori with or without sterile margins, and spermatangia form pale patches or small sori on the tip of branches (Santelice & Hommersand 1997, Shimada *et al*. 2000, Thomas & Freshwater 2001, Tronchin & Freshwater 2007, Sohrabipour *et al*. 2013).

A total of 18 species, including *Pterocladiella beachiae* Freshwater (2001: 346) recently reinstated (Freshwater *et al*. 2010, Sohrabipour *et al.* 2013), have been recognized in *Pterocladiella* (Guiry & Guiry 2016). Thallus size, branching pattern, shape of tetrasporangial sori with or without sterile margin, and position of cystocarps and spermatangial sori are important characters to recognize species (Santelices 1998, Shimada *et al*. 2000, Miller & Freshwater 2005, Tronchin & Freshwater 2007, Sohrabipoir *et al.* 2013). However, because *Pterocladiella* species displays considerable morphological variation, taxonomic determination of species needs evidence of comparative DNA sequences.

Our recent collection from the Philippines has included specimens of *Pterocladiella*, but their morphology did not accord with known species in marine algal flora of the Philippines (e.g. Silva *et al.* 1987): *P. caloglossoides* (Howe) Santelices (1998: 243), *P. capillacea*, and *P. nana* (Okamura) Shimada, Horiguchi & Masuda (2000: 16). Our specimens were rather similar to *P. megasporangia* J. Sohrabipour, S.M. Phang & P.-E. Lim in Sohrabipour *et al*. (2013: 523), *P. phangiae* J. Sohrabipour, P.-E. Lim & C.A. Maggs in Sohrabipour *et al*. (2013: 519), *P. yinggehaiensis* B.M. Xia & C.K Tseng in Xia *et al*. (2004: 206), and young plants of *P. caerulescens* (Kützing) Santelices & Hommersand (1997: 118). To identify our specimens by molecular markers, we analyzed mitochondrial *cox*1 and plastid *rbc*L sequences

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that are commonly used in the taxonomy of the Gelidiales (e.g. Freshwater *et al*. 1995, Freshwater *et al*. 2010, Boo *et al*. 2010, 2016a, b, Sohrabipour *et al*. 2013, Iha *et al*. 2015). On the basis of morphological observations and phylogenetic analyses of two genetic markers, we concluded that our specimens in Philippines represent a new species of gelidioid red algae, which we describe as *Pterocladiella maribagoensis* sp. nov. here.

Material & Methods

Five tufts of *Pterocladiella* were collected in intertidal zones at Maribago, Cebu, Philippines. Specimens were pressed onto herbarium sheets and subsamples were dehydrated in silica gel for molecular work. We also included two Asian species, *P. nana* and *P. tenuis* (Okamura) Shimada, Horiguchi & Masuda in Shimada *et al.* (2000: 17), as new addition to *cox*1 sequences in GenBank. Vegetative and reproductive features were observed under a microscope. For anatomical observation, thalli were sectioned using a freezing microtome (FX-801, Yamato Kohki Industrial Co., Ltd., Japan) and were stained with 1% aqueous aniline blue. Photographs were taken with a DP-71 camera (Olympus, Tokyo, Japan) mounted on a BX-51 microscope (Olympus, Tokyo, Japan). Type and voucher specimens are housed at the Herbarium of Department of Biology, Chungnam National University, Daejeon, Korea.

DNA extraction, PCR amplification, and sequencing were performed as described in Boo *et al*. (2013). The primers used for amplifying and sequencing were F7, F645, R753, and RrbcS start for *rbc*L (Freshwater & Rueness 1994, Lin *et al*. 2001), and COXI43F and COXI1549R for *cox*1 (Geraldino *et al*. 2006). Eight sequences (5 *cox*1 and 1 *rbc*L from Philippines specimens and each *cox*1 from *P. nana* and *P. tenuis*) generated in the present study are deposited in GenBank, and previously published sequences from 13 species of 18 *Pterocladiella* species were included for phylogenetic analyses (Table 1). A total of 29 *cox*1 sequences (1,279 base pairs) were aligned, including *Gelidiella acerosa* (Forsskål) Feldmann & G. Hamel (1934: 533), *Gelidium corneum* (Hudson) J.V. Lamouroux (1813: 129), and *Pterocladia lucida* (R. Brown ex Turner) J. Agardh (1851: 483) as outgroups. Thirty *rbc*L sequences (1,357 bp) were aligned using the same outgroups.

TABLE 1. Information on specimens used in the present study. Bold indicates sequences generated in the present study.

Species	Voucher	Collection site & date	*cox*1	*rbc*L
Gelidiella acerosa (Forsskål) Feldmann & G. Hamel	G5003	Mactan, Cebu, Philippines; 3 Jul. 2008	HM629886	HM629846
Gelidium corneum (Hudson) J.V. Lamouroux	G2483	Morocco; Nov. 2005	HM629861	HM629821
Pterocladia lucida (R. Brown ex Turner) J. Agardh	CNU055973	Cape Peron, Rockingham, Western Australia, Australia; 17 Jan. 2015	KT443955	KT443968
Pterocladiella australafricanensis E.M Tronchin & D.W. Freshwater	SA04-045	Ribbon Reef, Sodwana Bay, KwaZulu-Natal, South Africa; 19 Apr. 2004	HQ412472	EF190246
	SA04-072	Doodles Reef, Punta Do Ouro, Mozambique; 14 Apr. 2004	HQ412473	EF190247
	SA04-095	Texas Reef, Punta Do Ouro, Mozambique; 15 Apr. 2004	HQ412474	EF190248
	IBC0584	Enseada Azul, Meaípe, Espirito Santo, Brazil; 9 May 2012	KT208063	KT208127
Pterocladiella bartlettii (W.R. Taylor) Santelices	-	Cahuita, Limon, Costa Rica	-	AF305806
	-	Port Aransas, Texas, USA	-	AF305807
	PSM12495A	Pulau Pinang, Malaysia; 7 Sep. 2009	KC209081	KC209059

...Continued on next page

TABLE 1. (Continued)

Species	Voucher	Collection site & date	*cox*1	*rbc*L
	IBT0209	Praia Brava, Ubatuba, Sao Paulo, Brazil; 8 May 2009	KT208044	KT208122
	CNU025191	Sentosa Island, Singapore; 4 Apr. 2008	KU512781	KU512794
Pterocladiella beachiae Freshwater	CR12	Cahita, Limon, Costa Rica	HQ412477	AF305811
	PHYKOS-3213	Boca del Drago, Bocas, Panama; 27 Aug. 2009	HQ412478	HQ412496
	PSM12618A	Teluk Kemang, Malaysia; 25 Nov. 2011	KC209095	KC209076
	IBT0185	Rapada Island, Ubatuba, Sao Paulo, Brazil; 8 May 2009	KT208060	KT208126
Pterocladiella caerulescens (Kützing) Santelices & Hommersand	Pcaer-HI	Coconut Island, Oahu, Hawaii; 12 Mar. 1994	HQ412475	AF305805
	PSM12662	Port Dickson, Malaysia	KC209096	KC209072
	CNU025199	Sentosa Island, Singapore; 8 Apr. 2008	KU512787	KU512795
Pterocladiella caespitosa (Kylin) Santelices	-	Treasure beach, Durban Bluff, KwaZulu-Natal, South Africa	-	EF190243
Pterocladiella caloglossoides (M.A. Howe) Santelices	NSW-1	La Parouse, Botany Bay, New South Wales, Australia	-	AY352422
Pterocladiella capillacea (S.G. Gmelin) Santelices & Hommersand	P1251	Cheonbu, Ulreungdo, Korea; 21 Jun. 2006	HM629885	HM629845
Pterocladiella maribagoensis G.H. Boo & P.J.L. Geraldino, sp. nov.	CNU040562	USC Marine Station, Maribago, Cebu, Philippines; 23 Apr. 2013	**KX077936**	-
	CNU040565	USC Marine Station, Maribago, Cebu, Philippines; 23 Apr. 2013	**KX077937**	-
	CNU040566	USC Marine Station, Maribago, Cebu, Philippines; 23 Apr. 2013	**KX077938**	-
	CNU040567	USC Marine Station, Maribago, Cebu, Philippines; 23 Apr. 2013	**KX077939**	-
	CNU040569	USC Marine Station, Maribago, Cebu, Philippines; 23 Apr. 2013	**KX077940**	**KX077943**
Pterocladiella megasporangia J. Sohrabipour, P.E. Lim & C. A. Maggs	PSM12599	Port Dickson, Teluk Kemang, Malaysia; 29 Aug. 2011	KC209087	KC209065
Pterocladiella melanoidea (Schousboe ex Bornet) Santelices & Hommersand	-	Mallorca, Spain	-	U01046
Pterocladiella nana (Okamura) Shimada, Horiguchi & Masuda	CNU009400	Sungsan, Jeju, Korea; 4 Jul. 2011	**KX077941**	-
	P1352	Eoyoung, Jeju, Korea	-	GU731224

...Continued on next page

TABLE 1. (Continued)

Species	Voucher	Collection site & date	*cox*1	*rbc*L
Pterocladiella phangiae J. Sohrabipour, P.E. Lim & C. A. Maggs	PSM12504	Port Dickson, Malaysia; 30 Dec. 2009	KC209090	KC209078
Pterocladiella psammophila Tronchin & Freshwater	SA04-042	Ribbon Reef, Sodwana Bay, KwaZulu-Natal, South Africa; 19 Apr. 2004	HQ412483	EF190255
Pterocladiella sp.	IBT0257	Eden, Guaruja, Sao Paulo, Brazil; 1 Nov. 2009	KT208091	KT208131
Pterocladiella tenuis (Okamura) Shimada, Horiguchi & Masuda	CNU060056	Hyeongjeseom, Goheung, Korea; 1 May 2008	**KX077942**	-
	P0868	Geomundo, Korea	-	GU731220

Phylogenies of individual and combined datasets were inferred using maximum likelihood (ML) and Bayesian inference (BI). PartitionFinder v1.1.0 (Lanfear *et al*. 2012) was used to select the best-fitting partitioning schemes and substitution models using the greedy algorithm with unlinked branch lengths. The best-fitting partitioning scheme as evaluated by PartitionFinder was GTR + G + I substitution model with non-partitioning for combined dataset and GTR + G substitution model for the each individual dataset. The ML analyses were performed using the Pthreads version of RAxML v8.0.X (Stamatakis, 2014) set as follows: a rapid bootstrap analysis and search for the best-scoring ML tree in one single program run with 1,000 bootstrap replicates.

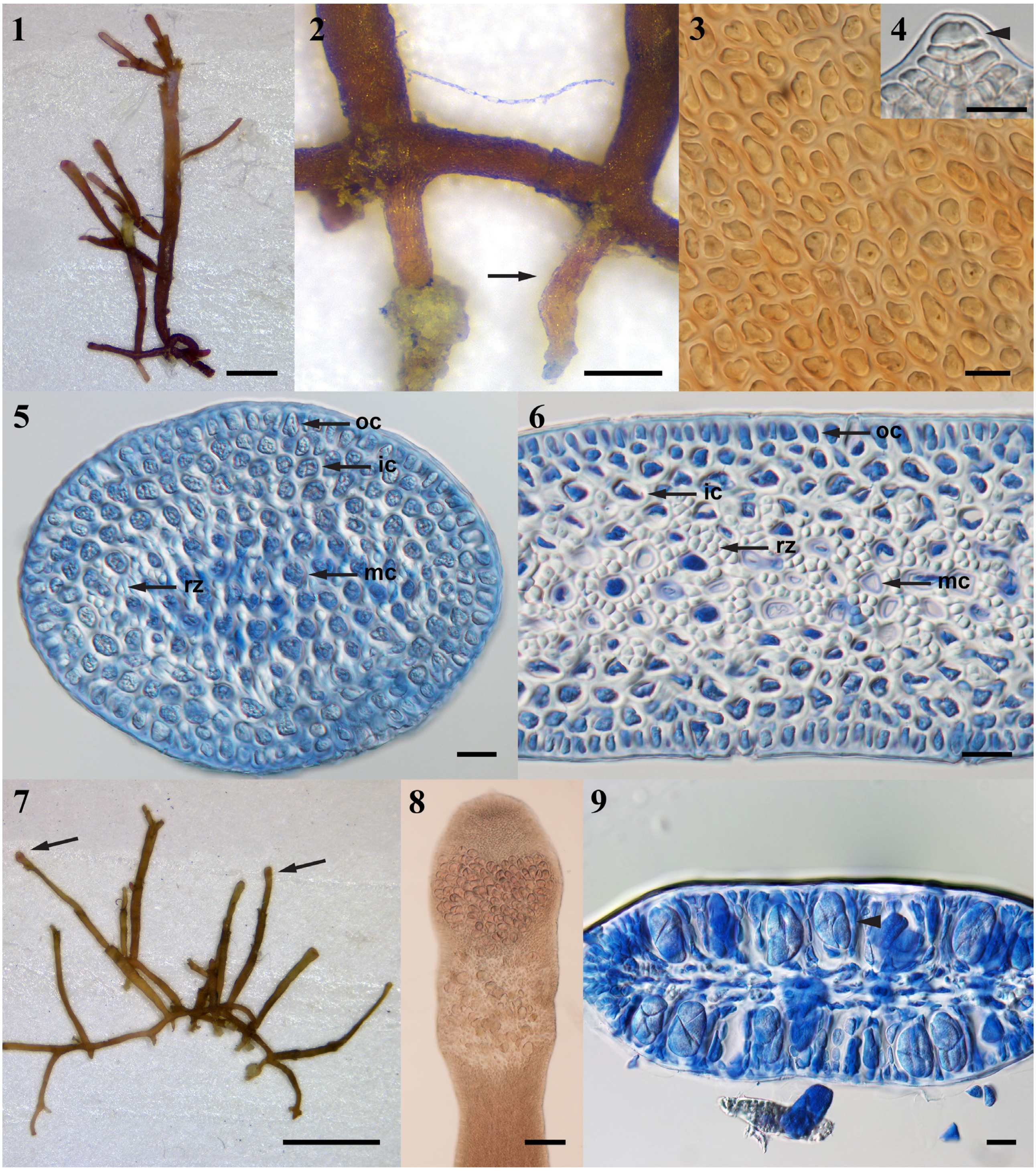
Bayesian inference (BI) was performed for individual datasets with MrBayes v.3.2.1 (Ronquist *et al*. 2012) using the Metropolis-coupled Markov Chain Monte Carlo (MC3) based on the best-fitting partitioning scheme and substitution models as evaluated with PartitionFinder. For each matrix, two million generations of two independent runs were performed with four chains and sampling trees every 100 generations. The burn-in period was identified graphically by tracking the likelihoods at each generation to determine whether they reached a plateau. Twenty-five percent of saved trees were removed, and the remaining trees were used to infer Bayesian posterior probabilities (BPP).

Results

Pterocladiella maribagoensis G.H. Boo & P.J.L. Geraldino, sp. nov. (Figs 1–9)

Type:—PHILIPPINES. Cebu, Maribago, at the front of Marine Station, University of San Carlos, 9° 53' N, 124° 13' E, intertidal rock, 23 April 2013, *G.H. Boo & P.J.L. Geraldino* (holotype CNU040562 in CNUK [Department of Biology, Chungnam National University, Daejeon, Korea]; isotypes CNU040567, CNU040569).

Plants up to 0.8 cm high, light red in colour, consisting of prostrate stolons and erect axes (Fig. 1). Prostrate stolons terete, being 230–270 μm in diameter, rarely branched, attached to substrata by peg-like haptera arising at intervals from the basal side of prostrate stolons (Fig. 2). Erect axes arising on the opposite side of stolons where rhizoids occurred (Fig. 1), basally terete, then compressed along the erect axes, being 158–380 (–570) μm in diameter. Branches determinate to indeterminate mostly with two or rarely three orders of branching: determinate branches usually in alternate pattern, indeterminate branches in irregular pattern. Surface cells polygonal (Fig. 3), approximately 6–10 μm in diameter. Apical cells single, dome shaped (Fig. 4).



FIGURES 1–9. *Pterocladiella maribagoensis* G.H. Boo & P.J.L. Geraldino, *sp. nov.* 1. Habit of a plant with pinnate branching (CNU040562). 2. A peggy-like hapteron (arrow). 3. Irregularly arranged outermost cortical cells in surface view. 4. Apex of an upright branch showing a dome-shaped apical cell (arrowhead). 5. Transverse section of a prostrate stolon showing the outermost cortical cells (oc), inner cortical cells (ic), rhizines (rz) and medullary cells (mc). 6. Transverse section of an erect branch showing the outermost cortical cells (oc), inner cortical cells (ic), rhizines (rz) and medullary cells (mc). 7. Plant with tetrasporangial sori at the tips of flattened branches (arrows) (CNU040567). 8. Tetrasporangial sorus with irregularly arranged tetrasporangia. 9. Transverse section of a tetrasporangial sorus with cruciately divided tetrasporangium (arrowhead). Scale bars: Fig. 1 = 1 mm; Fig. 2 = 0.2 mm; Figs 3–4 = 10 µm; Figs 5–6, 9 = 20 µm, Fig. 7 = 2 mm; Fig. 8 = 100 µm.

In the transverse section, prostrate stolons consisted of three to four layers of cortical cells (Fig. 5). Outermost cortical cells ovoid to rounded, 3–9 µm wide and 7–13 µm long; inner cortical cells 8–14 µm in diameter. Medullary cells were 9–14 µm in diameter and mainly isodiametric (Fig. 5). Rhizines abundant in inner cortical layers (Fig. 5).

Erect axes composed of three to four layers of pigmented cortical cells (Fig. 6). Outermost cortical cells oblong to rounded, 2–6 µm wide and 7–13 µm long; inner cortical cells larger, 8–13 µm in diameter. Medulla consisting of three to four transverse rows of colorless polygonal cells, 8–14 µm in diameter (Fig. 6). Rhizines translucent, abundant in medulla (Fig. 6).

Tetrasporangial sori subterminal, arising on ultimate ligulate branches and branchlets (Fig. 7); tetrasporangia irregularly arranged in tetrasporangial sori without sterile margins (Fig. 8). Tetrasporangia divided cruciately (Fig. 9), being 15–32 µm wide and 30–60 µm long. Male and female plants not observed.

Morphological differences of *P. maribagoensis* from similar species are provided in Table 2.

Distribution and Habitat:—*Pterocladiella maribagoensis* is currently known from Maribago, Cebu, Philippines. It grows on rocks at intertidal zone.

Etymology:—The specific epithet is derived from Maribago, Cebu, Philippines where type was collected.

Identification using mitochondrial *cox*1 and plastid *rbc*L sequences:—Eight sequences generated in the present study: five *cox*1 and one *rbc*L from *P. maribagoensis* and each *cox*1 from *P. nana* and *P. tenuis*. Five *cox*1 sequences of *P. maribagoensis* were identical. Interspecific divergences between *P. maribagoensis* and the other species ranged from 10.6% (vs *P. phangiae*) to 15.8% (vs *Pterocladiella* sp. from Brazil). In *rbc*L, interspecific divergences between *P. maribagoensis* and the other species ranged from 4.9% (vs *P. psammophila*) to 11.8% (vs *P. megasporangia*).

The topology of the ML and BI trees was largely congruent, and only the ML tree was shown for the combined dataset (*cox*1 + *rbc*L) (Fig. 10). Both topologies of the *cox*1 and *rbc*L alone were similar to the combined phylogeny but with weaker statistical supports (Figs S1–S2). The combined tree included 33 taxa (2,636 bp) and the monophyly of the genus *Pterocladiella* was strongly supported (99% ML, 1.0 BPP). *Pterocladiella maribagoensis* was distinct from other species of *Pterocladiella* in phylogenies of both individual and combined datasets (Fig. 10, Figs S1, S2). *Pterocladiella maribagoensis* formed a clade with *P. australafricanensis*, *P. beachiae*, *P. caerulescens*, *P. phangiae*, and *P. psammophila* (100% ML, 1.0 BPP).

Discussion

Our study on morphology and both of mitochondrial *cox*1 and plastid *rbc*L sequences clearly demonstrates the occurrence of *Pterocladiella maribagoensis*, a new species of marine red algae at Maribago beach, Cebu, Philippines. *Pterocladiella maribagoensis* is distinguished by a combination of small-sized thalli, compressed, thick erect axes with alternate, determinate branches, peg-like haptera, three to four transverse rows of medullary cells and abundant rhizines in medulla of erect axes, and tetrasporangial sori without sterile margin at the terminal of branches. Considering its diminutive size (approximately 0.8 cm), intensive collections may extend its distribution to surrounding waters.

Of a total of 18 species of *Pterocladiella*, 13 species have been included in *cox*1 and/or *rbc*L phylogenies in the present study, and both topologies are similar with those in previous studies (e.g. Shimada *et al.* 2000, Freshwater *et al*. 2010, Sohrabipour *et al*. 2013, Iha *et al*. 2015, Boo *et al.* 2016b). *Pterocladiella maribagoensis* is morphologically similar to *P. phangiae*, however, *P. phangiae* has a corymbose habit with lateral branches arising at right angles to main axis, and tetrasporangial sori with sterile margin (Sohrabipour *et al*. 2013). Both branches arising at right angles and sterile margin in tetrasporangial sori are used as diagnostic characters of species in the Gelidiales as well as *Pterocladiella* (Millar & Freshwater 2005, Sohrabipour *et al*. 2013). *Pterocladiella maribagoensis* is also identifiable from other small-sized species from Australia and southeast Asia. For example, *Pterocladiella minima* (Guiry & Womersley) Santelices & Hommersand (1997: 118) (basionym, *Gelidiella minima* Guiry & Womersley, 1992: 166) is characterized by largely rosette-like prostrate axes and six tetrasporangia per row (Guiry & Womersley 1992). *Pterocladiella megasporangia* is distinguished by unilateral to polytrichous apical branches and the absence of sterile margins in tetrasporangial sori (Sohrabipour *et al.* 2013). *Pterocladiella yinggehaiensis* is characterized by dense palmate branches on the middle to upper parts of main axes. *P. maribagoensis* is similar to young plants of both *P. beachiae* and *P. caerulescens* that have relatively wide distributions. *P. beachiae*, however, is approximately 3 cm high, with irregular to pinnate branches or unbranched erect axes and tetrasporangial sori without sterile margin, and *P. caerulescens* (basionym, *Gelidium caerulescens* Kützing, 1868: 19) is 3–7 cm high, with thick blade and tetrasporangia without sterile margin (Thomas & Freshwater 2001, Tronchin & Freshwater 2007, Sohrabipour *et al*. 2013).

TABLE 2. A comparison of *Pterocladiella maribagoensis* and similar species.

Characteristics	*P. maribagoensis* G.H. Boo & P.J.L. Geraldino	*P. beachiae* Freshwater	*P. caerulescens* (Kützing) Santelices & Hommersand	*P. megasporangia* J. Sohrabipour, S.M. Phang & P.-E. Lim	*P. minima* (Guiry & Womersley) Santelices	*P. phangiae* J. Sohrabipour, P.-E. Lim & C.A. Maggs	*P. yinggehaiensis* B.M. Xia & C.K. Tseng
Type locality	Maribago, Cebu, Philippines	Cahuita, Limon, Costa Rica	Wagap, New Caledonia	Teluk Kemang, Port Dickson, Negri Sembilan, Malaysia	Point Lonsdale, Victoria, Australia	Port Dickson, Negeri Sembilan, Malaysia	Yinggehai, Hainan Island, China
Habitat	on rock in sheltered places in the intertidal zone	on rock in intertidal zone	on rocks or shells in the intertidal to subtidal zones	epilithic or on coral mixed with *P. beachiae* and *P. caerulescens* in mid-intertidal zone	on encrusting coralline algae in shallow subtidal waters	on rocks and sand-covered boulders in mid-intertidal zone	on lower intertidal rocks
Thallus size	up to 0.8 cm	up to 2.5 cm	6–8 cm	less than 0.5 cm	1–2 cm	less than 1 cm	1–2 cm
Branching pattern	alternate, irregular	pinnate to alternate at margin	simple, alternate to quadripinnate	unilateral to polytrichous, rarely irregular	rosette at the base, unbranched	right angle, irregular, alternate	densely palmate in the middle
Order of branching	2, rarely 3	up to 3	up to 3	1	ubranched	up to 3	up to 3
Basal constriction of 2nd branches	present	present	present	absent	absent	present	slightly constricted
Rhizines	abundant in medulla	abundant in central medulla	abundant in medulla	few near medulla	a string of thick-walled 6–11 cells in the center	abundant in medulla	rare in medulla
Cystocarps	not found	unequal, bilocular	elongate cylindrical swellings with two unequal locules	not found	unilocular with single ostiole	not found	unilateral, prominently protruding, triangular
Spermatangia	not found	small patches	small patches	not found	small patches on subterminal sori	not found	not found
Tetrasporangial sori	terminal on branches without sterile margin	terminal to subterminal, without sterile margin	terminal on main axes or branches without sterile margin	lateral stichidium-like branchlets, constricted at base and short-stalked; without sterile margin	terminal, or occasionally on lateral branches without sterile margin	apical and lateral, compressed with sterile margin	not found
Tetrasporangia arrangement	irregular	irregular	irregular	v-shaped	transverse rows of about six sporangia on each side of sori	v-shaped to irregular	not found
Distribution	Philippines (Cebu)	Costa Rica, Caribbean sea, Malaysia	Hawaii, Japan, New Caledonia, South Africa, Southeast Asian region	Malaysia	Australia (Southern Australia)	Malaysia	China (Hainan)
References	this study	Thomas & Freshwater 2001, Sohrabipour *et al.* 2013	Santelices 1998, Tronchin & Freshwater 2007, Boo *et al.* 2016b	Sohrabipour *et al.* 2013	Guiry & Womersley 1992	Sohrabipour *et al.* 2013	Xia *et al.* 2004

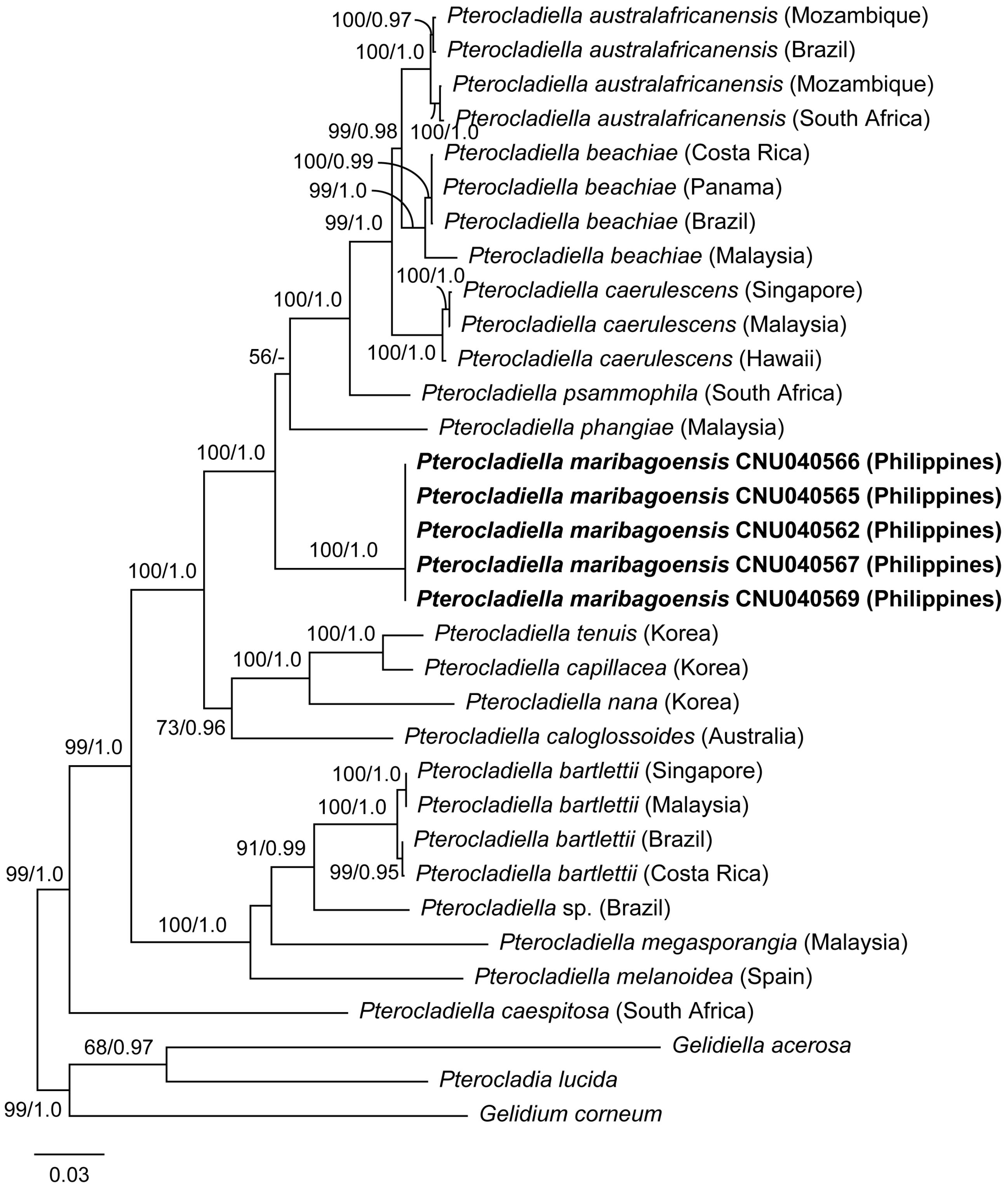


FIGURE 10. Maximum likelihood tree of the combined (*cox*1 + *rbc*L) dataset from *Pterocladiella*. The numbers above or below the nodes are RAxML bootstrap values and Bayesian posterior probabilities. Only bootstrap values ≥50% and Bayesian posterior probabilities ≥ 0.90 are shown in the tree.

Pterocladiella maribagoensis is clearly distinct from *P. capillacea*, *P. nana*, and *P. tenuis* from Korea and Japan in its small size, and *cox*1 and *rbc*L sequences (Shimada *et al*. 2000, Boo *et al*. 2010). It is also easily distinguishable from three other species that have not analyzed for DNA sequences: *P. bulbosa* (N.H. Loomis) Santelices (1997: 306), *P. sanctarum* (Feldmann & Hamel) Santelices (2007: 298), and *P. taylorii* (Joly) Santelices (2007: 298). *Pterocladiella bulbosa* (basionym, *Pterocladia bulbosa* Loomis, 1960: 7) is characterized by simple thalli with a few linear branches, stalked branches of tetrasporangia, and terminating in bulbous sporangial tips (Loomis 1960). *Pterocladiella sanctarum* (basionym, *Gelidiella santarum* Feldmann & Hamel, 1934: 549) is characterized by simple thallus with rarely irregular branches. *Pterocladiella taylorii* (basionym, *Gelidiella taylorii* Joly, 1957: 102) is reported in Philippines (Silva *et al*. 1987), but it is distinguished from *P. maribagoensis* by simple and somewhat wide thalli without branches (Santelices 2007).

Our study provides the first new species of *Pterocladiella* in the Philippines, where many red algae have been reported. *Pterocladiella* is now updated to 19 species in world inventory of red algae, and the number of species will increase with further collections in tropical waters where most species of the Gelidiales are small-sized.

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