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# Second addendum to the synoptic review of red algal genera

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## Review

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# Second addendum to the synoptic review of red algal genera

**Abstract:** A second addendum to Schneider and Wynne's (Schneider, C.W. and M.J. Wynne. 2007. A synoptic review of the classification of red algal genera a half a century after Kylin's "Die Gattungen der Rhodophyceen". Bot. Mar. 50: 197–249.) "Synoptic review" of red algal genera and their classification is presented, with an updating of names of new taxa at the generic level and higher. In the past few years, the hierarchy of some genera has changed due to new subfamilies, which are cited and referenced below. There have also been the descriptions of some higher taxa in the past few years.

**Keywords:** classification; genera; Kylin; red algae; Rhodoplantae.

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## Introduction

Gene sequencing and the resulting construction of phylogenetic trees continue to add to our knowledge of red algal genera and the classification of the Rhodophyta. Such molecular-based phylogenies often have shown the need to recognize segregate entities, at times necessitating the description of new genera or the resurrection of older generic names that had come to be treated as taxonomic synonyms using criteria based on the classical morphology and reproduction. Following the publication of Schneider and Wynne's (2007) "Synoptic review...of red algal genera," and our first addendum to it (Wynne and Schneider 2010), additional changes have appeared, leading us to issue this second addendum. Furthermore, we continue to find obscure valid names that we had overlooked in the synoptic review. We will periodically provide further addenda as sufficient new published information on red algal genera and classification appears.

The flood of new data coming in from the gene-sequence analyses is not only revealing the cases where some genera need to be split up and where others were cases of cryptic-speciation but also where some genera and even families have been placed in orders where they clearly no longer belong. The red algal tree of life depicted by Verbruggen et al. (2010, figure 2), reconstructed using the Bayesian phylogenetic inference of DNA data mined from GenBank, reveals a contemporary view of our current understanding of the classification in the red algae at the class, subclass, order, and family levels. Their tree includes some taxa (*Atractophora*, Calosiphoniaceae, Inkyuleaceae, and Peyssonneliaceae), in which their traditional assignments are not supported by the present gene-sequence data.

With regard to the current realignment and descriptions of the many red algal genera due to molecular phylogenetics, it is worthwhile to refer to the ongoing discussion of the reliability of obtaining a DNA sequence data from the "archival" red algae. On one hand, some workers have questioned how successful the DNA extraction and sequencing can be for specimens older than about a dozen years (Saunders and McDevit 2012). On the other hand, other workers claim that the protocols have been successfully devised for the sequencing of the genes from the specimens going back into the early 19th century (Hughey and Gabrielson 2012). Confirmation of the results from the archival specimens with the DNA obtained from the recent collections from the same type localities should assist in resolving these questions.

## Format of the list

The same format that was employed in the previous synoptic review and the first addendum (Schneider and Wynne 2007, Wynne and Schneider 2010) is followed in this second addendum. All the genera established after Kylin (1956) and added here have the authorities who described them, as well as the year and page of the protolog printed in bold face along with the proper names.

The “References” section contains the literature cited for the protologs of the genera since Wynne and Schneider (2010), as well as that not covered by Kylin (1956) and Schneider and Wynne (2007).

## Kingdom Plantae

### Phylum Rhodophyta

#### Subphylum Rhodellophytina

#### Class Rhodellophyceae

#### Order Dixoniellales

#### Family Dixoniellaceae

Note: Wynne and Schneider (2010) considered this family a synonym of the Glaucosphaeraceae based upon the rule of nomenclatural priority. Since then, however, the Glaucosphaeraceae was emended by Scott et al. (2011, 2012) to include only *Glaucosphaera* and transferred to the new order Glaucosphaerales [below]. This realignment of the Glaucosphaeraceae excluded *Dixoniella* and *Neorhodella* from the family, allowing the resurrection of the Dixoniellaceae to accommodate them (Scott et al. 2011, 2012).

#### ***Bulboplastis* Kushibiki, A. Yokoyama, M. Iwataki, J.A. West et Y. Hara 2012: 116.**

Note: *Bulboplastis* was considered a member of the Dixoniellaceae when described by Kushibiki et al. (2012), and it would remain there given its phylogenetic association with *Dixoniella* and *Neorhodella* despite *Glaucosphaera* being segregated into its own order (Scott et al. 2012).

#### **Order Glaucosphaerales E.C. Yang, J.L. Scott, S.Y. Yoon et J.A. West 2012: 71.**

Note: The initial proposal by Yang et al. in Scott et al. (2011) to establish this order was not valid due to the lack of the Latin diagnosis and designation of the type family. The requirement for a Latin diagnosis lapsed beginning January 1, 2012, and so Yang et al. in Scott et al. (2012), with a diagnosis in English, later validated the name of the order and designated the type family to be the Glaucosphaeraceae Skuja (1954).

#### Class Porphyridiophyceae

#### Order Porphyridiales

#### Family Porphyridiaceae

#### ***Timspurckia* E.C. Yang, J.L. Scott et J.A. West 2010: 606.**

#### Subphylum Metarhodophytina

#### Class Compsopogonophyceae

#### Order Erythropeltidales

#### Family Erythrotrichiaceae

#### ***Erythrotrichia* Aresch. 1850: 435. *nom. cons.***

Note: Zuccarello et al. (2011) showed that *Erythrotrichia sensu lato* comprised at least seven well-supported infra-generic lineages, and the authors recognized the difficulty of linking these genetic groupings with the more than two dozen species names currently associated with the genus. They observed that the morphology and, at times, overlapping geographic locations of their isolates were not useful in tying these cryptic species to the historical binomials. Two species of *Erythrotrichia* were transferred to *Porphyrostromium*.

#### Subphylum Eurhodophytina

#### Class Bangiophyceae

#### Order Bangiales

#### Family Bangiaceae

#### ***Porphyra* C. Agardh 1824: xxxii, 190. *nom. cons.***

Note: Several genera have, over the years, been subsumed under the speciose *Porphyra* (Schneider and Wynne 2007, Wynne and Schneider 2010). With the advances of molecular genetics in taxonomy, the workers have begun to find distinctions of the species at the generic level, and two genera (see below) with a large number of taxa have been resurrected for the genetic groupings that segregate them from *Porphyra* (Sutherland et al. 2011).

#### ***Boreophyllum* S.C. Lindstr., N. Kikuchi, M. Miyata et Neefus in Sutherland et al. 2011: 1140.**

#### ***Clymene* W.A. Nelson in Sutherland et al. 2011: 1138.**

#### ***Fusciolum* S.C. Lindstr. in Sutherland et al. 2011: 1139.**

#### ***Lysithea* W.A. Nelson in Sutherland et al. 2011: 1139.**

#### ***Miuraea* N. Kikuchi, S. Arai, G. Yoshida, J.A. Shin et M. Miyata in Sutherland et al. 2011: 1137.**

#### ***Pyropia* J. Agardh 1899: 149.**

Note: Formerly considered a taxonomic synonym of *Porphyra* (Wynne and Schneider 2010), this genus was resurrected for more than 75 species, leaving it as the most speciose genus in the Bangiales (Sutherland et al. 2011).

#### ***Wildemanina* G. De Toni 1890: 144, 148.**

Synonym: ***Diploderma* Kjellm. (1893) *nom. illeg.* (non Link 1816)**

Note: *Wildemanina* was resurrected by Sutherland et al. (2011) from *Porphyra* where it was considered a taxonomic synonym (Schneider and Wynne 2007).

**Class Florideophyceae****Subclass Hildenbrandiophycidae****Order Nemaliales****Family Liagoraceae**

***Neozziella* S.-M. Lin, S.-Y. Yuan *et* Huisman 2011: 253.**

***Macrocarpus* S.-M. Lin, S.-Y. Yuan *et* Huisman 2011: 258.**

Note: Lin *et al.* (2011) based *Macrocarpus* on *Liagora perennis* I.A. Abbott.

***Sinocladia* C.K. Tseng *et* W. Li 2005: 53 [Chinese], 163 [Latin].**

Note: Zeng (Tseng) *et al.* (2005) placed their new genus in the Dermonemataceae, a family considered by most workers as a synonym of the Liagoraceae (Huisman 2006).

***Yoshizakia* S.-M. Lin, Huisman *et* Payri 2013: 164.**

**Order Palmariales****Family Rhodophysemataceae**

***Rhodophysema* Batters 1900: 377.**

Synonym: ***Halosaccicolax* S. Lund (1959) *nom. inval.***

Note: Saunders and Clayden (2010) provided a valid epithet for the species known as *Halosaccicolax kjellmanii* S. Lund, an invalidly published entity, after finding it grouped with the genus *Rhodophysema* (Clayden and Saunders 2010) in their COI-5P phylogenetic analyses.

**Subclass Corallinophycidae****Order Corallinales****Family Corallinaceae****Subfamily Corallinoideae**

***Corallina* L. 1758: 805.**

Synonyms: ***Marginosporum* (Yendo) Ganesan (1968); *Serraticardia* (Yendo) P.C. Silva (1957); *Titanephilum* Nardo (1834); *Yamadaia* [***Yamadaea***] Segawa (1955).**

Note: Hind and Saunders (2013) presented a molecular phylogenetic evidence to propose the merger of both *Marginosporum* and *Serraticardia* within *Corallina*. The spelling we used previously, “*Titanephilum*” (Schneider and Wynne 2007), should be *Titanephilum*. The genus *Yamadaia* was reduced to a synonym of *Corallina* by virtue of Martone *et al.* (2012) transferring the generitype species, *Y. melobesioides* Segawa, into *Corallina*. The only other species, *Y. americana* E.Y. Dawson *et* R.L. Steele, was transferred into *Chiharaea* (Martone *et al.* 2012). With regard to the spelling of the name, the original spelling was *Yamadaia*, and Johansen (1969) altered it to *Yamadaea*. We notice a conflict in the *International Code of Nomenclature for algae, fungi, and plants* (Melbourne Code) (<http://www.iapt-taxon.org/nomen/main.php>)

between Art. 60.1, which states that “The original spelling of a name or epithet is to be retained,” and Recommendation 60B.1(a), which states that for a generic name derived from a surname ending in a vowel, the letter “-a” is added, except for a name ending in “-a,” in which case “-ea” is added. We accede to the Article rather than the Recommendation and, thus, accept Segawa’s (1955) original spelling.

***Ellisolandia* K. Hind *et* G.W. Saunders 2013: 109.**

Note: This segregate genus was based on *Corallina elongata* J. Ellis *et* Solander (Hind and Saunders 2013).

***Johansenia* K. Hind *et* G.W. Saunders 2013: 111.**

Note: This segregate genus was based on *Serraticardia macmillanii* (Yendo) P.C. Silva following the transfer of the type species of *Serraticardia*, *S. maxima* (Yendo) P.C. Silva, to *Corallina*.

***Pachyarthron* Manza 1937: 45.**

Note: Sato *et al.* (2009) suggested that *Pachyarthron* should be subsumed under *Corallina* on comparisons of multiple gene sequences, including those of the generitype, *P. cretaceum* (Postels *et* Rupr.) Manza. We await a more formal presentation of these results. The genus *Pachyarthron* has a confused nomenclatural history with *Bossiella* (Schneider and Wynne 2007), and at present, the two genera are considered distinct (Wynne and Schneider 2010).

**Subfamily Lithophylloideae**

***Amphiroa* J.V. Lamour. 1812: 186.**

Synonym: ***Eurytion* (Decne.) Lindl. (1846)**

Note: This synonym was omitted in Schneider and Wynne (2007). The genus was first recognized as section *Eurytion* of *Amphiroa* by Decaisne (1842), before being elevated by Lindley (1846).

**Subfamily Mastophoroideae**

Note: Kato *et al.* (2011) revised this subfamily created by Setchell (1943) to include only the genera *Mastophora* and *Metamastophora*.

**Subfamily Hydrolithoideae A. Kato *et* M. Baba 2011: 669.**

Note: This new subfamily was created to include *Hydrolithon* (Kato *et al.* 2011).

**Subfamily Porolithoideae A. Kato *et* M. Baba 2011: 669.**

Note: At present, this new subfamily includes only *Porolithon* (Kato *et al.* 2011).

**Subfamily Neogoniolithoideae A. Kato et M. Baba 2011: 669.**

Note: This new subfamily was created to include *Neogoniolithon* (Kato et al. 2011).

**Subclass Rhodmeniophycidae**

**Order Ceramiales**

**Family Delesseriaceae**

***Hymenenopsis* S.-M. Lin, W.A. Nelson et Hommersand 2012: 64.**

Note: This new genus is based on the new species *Hymenenopsis heterophylla*, which had previously gone under the name of *Hymenena palmata* f. *marginata sensu* Kylin from New Zealand (Lin et al. 2012b).

***Paraglossum* (J. Agardh) J. Agardh 1898: 213.**

Note: Using morphological and molecular studies, Lin et al. (2012a) showed that *Paraglossum* should be reinstated to include certain Southern Hemisphere species that had been placed in *Delesseria*. Earlier, *Paraglossum* had been relegated as a junior synonym of *Delesseria* (Schneider and Wynne 2007). Lin et al. (2012) showed that *Paraglossum* and *Apoglossum* were closely related genera in the newly described tribe Apoglosseae of the Delesseriaceae.

**Family Rhodomelaceae**

***Erythrocytis* J. Agardh 1876: 638.**

Synonym: ***Ricardia* Derb. et Sol. 1856: 211.**

Note: The name *Ricardia* was inadvertently omitted by Kylin (1956) and Schneider and Wynne (2007). Silva (1952) has reviewed the nomenclatural history of the names *Erythrocytis* and *Ricardia*.

***Laurenciella* Cassano, Gil-Rodríguez, Senties, Díaz-Larrea, M.C. Oliveira et M.T. Fujii 2012: 354.**

Note: On the basis of molecular data alone, this genus was segregated from *Laurencia* by Cassano et al. (2012) to include *L. marilzae* Gil-Rodríguez, Senties, Díaz-Larrea, Cassano et M.T. Fujii.

***Lampisiphonia* H.-G. Choi, Díaz Tapia et Bárbara in Bárbara et al. 2013a: 138.**

***Symphyocolax* M.-S. Kim in Kim et Cho 2010: 106.**

Note: This genus is a parasite of *Symphyocladia* (Kim and Cho 2010).

**Order Gelidiales**

**Family Gelidiaceae**

***Gelidium* J.V. Lamour. 1813: 128. nom. cons.**

Synonym: ***Porphyroglossum* Kütz. (1847)**

Note: The merger of the monotypic genus *Porphyroglossum* into *Gelidium* was proposed by Kim et al. (2011a). Their initial binomial, *Gelidium zollingeri* (Kütz.) comb. nov., however, was a later homonym of that by Sonder (1854), and so they proposed the *nomen novum* *Gelidium indonesianum* K.M. Kim, G.S. Gerung et S.M. Boo (Kim et al. 2011b).

**Order Gigartinales**

**Family Caulacanthaceae**

***Sterrocladia* F. Schmitz 1893: 77.**

Note: A second species was added to this uniquely freshwater gigartinean genus. Using the comparative gene-sequence data, Sherwood et al. (2012) showed *Sterrocladia* to be in a basal position relative to the Gigartinaceae and Phylloporaceae and may well represent a new family. However, they believed that fresh collections of the generic type species, *S. amnica* (Mont.) F. Schmitz, from northern South America, were needed for the final disposition.

**Family Chondrymeniaceae Rodríguez-Prieto, G. Sartoni, S.-M. Lin et Hommersand 2013: in press.**

Note: The genus *Chondrymenia* Zanardini had previously been included in the Sarcodiaceae of the order Plocamiales (Schneider and Wynne 2007). But on the basis of *rbcL* gene sequence analyses, Rodríguez-Prieto et al. (2013) demonstrated that the genus was more closely allied with the Cystocloniaceae-Solieriaceae complex and justified being separated as a distinct family in the order Gigartinales.

**Family Cruoriaceae**

***Pseudopolyides* Gallardo, Bárbara et Cremades in Bárbara et al. 2013b: 193.**

**Family Gigartinaceae**

***Psilophycus* W.A. Nelson, Leister et Hommersand 2011: 220.**

Note: Based upon the morphological and reproductive characteristics, Nelson et al. (2011) found this genus to be basal to the other genera in the family, containing unique features thus far not found in the other genera of the family.

**Family Kallymeniaceae**

Note: Based upon the multigene analyses, Clarkston and Saunders (2012) placed *Beringia*, *Erythrophyllum*,



*Kallymeniopsis*, and *Hommersandia* in the Kallymeniaceae rather than the Crossocarpaceae where they previously had been treated.

***Ectophora*** 1876: 689.

Note: As pointed out by D'Archino et al. (2011), *Ectophora* has had a complicated taxonomic history with periods as a synonym of *Callophyllis* and others as a discrete generic entity. Using multiple genetic markers, D'Archino et al. (2011) demonstrated that it demanded status at the generic level.

***Salishia* Clarkston et G.W. Saunders 2012: 51.**

Note: Clarkston and Saunders (2012) based their new genus on *Pugetia firma* Kylin.

***Stauromenia* D'Archino, W.A. Nelson et Zuccarello 2012: 452.**

**Family Phylloporaceae**

***Archestenogramma* C.W. Schneid., Chengsupanimit et G.W. Saunders 2011: 447.**

Note: Along with a new species described from Bermuda, Schneider et al. (2011) included *Leptofaucha brasiliense* A.B. Joly in their new genus, a species that Dalen and Saunders (2007) had excluded from the Faucheaceae (Rhodymeniales).

***Coccotylus*** Kütz. 1843

Synonym: ***Ceratocolax*** Rosenv. (1898)

Note: Using the *rbcl* gene sequences and morphological investigations, Le Gall and Saunders (2010) found that the generitype and only species of the parasitic *Ceratocolax* was better assigned to *Coccotylus*, rendering the genus synonymous.

**Family Schmitziellaceae Guiry, Garbary et G.W. Saunders in Guiry, 2012: 183**

Note: Guiry et al. (in Guiry, 2012) described this new family, based on the genus *Schmitziella*, and provisionally assigned it to the order Gigartinales.

**Order Peyssonneliales**

Note: When pointing out the incorrect placement of the Peyssonneliaceae as a family of the Gigartinales, Verbruggen et al. (2010) were unaware of it already having been moved into its own order (Krayesky et al. 2009, Wynne and Schneider 2010).

**Family Peyssonneliaceae**

***Incendia* K.R. Dixon in Dixon and Saunders 2013: 84.**

***Sonderophycus*** Denizot 1968: 206, 307.

Synonym: ***Sonderopelta*** Womersley et Sinkora (1981)

Note: Using both the chloroplast and nuclear DNA sequence data, Krayesky et al. (2009) demonstrated that the type species of *Sonderophycus* (*S. australis*) and *Sonderopelta* (*S. coriacea*) belonged in a single genus that was distinct from *Peyssonnelia*. However, they chose to recognize the junior name, *Sonderopelta*. Wynne (2011) pointed out that *Sonderophycus* has the priority over *Sonderopelta* and that the correct name for the type species is *Sonderophycus capensis* (Mont.) M.J. Wynne.

**Order Halymeniales**

**Family Halymeniaceae**

***Dermocorynus*** P.L. Crouan et H.M. Crouan 1858: 69.

Note: Contrary to the findings of Wilkes et al. (2005), Gargiulo et al. (2013) resurrected *Dermocorynus* from the synonymy with *Grateloupia* using reproductive and molecular data.

***Glaphyrosiphon* Hommersand et Leister in Hommersand et al. 2010: 558.**

***Grateloupia*** C. Agardh 1822: 221. *nom. cons.*

Synonym: ***Sinotubimorpha*** W.X. Li et Z.F. Ding (1998)

Note: Sheng et al. (2012) critically assessed the morphological features of two closely related red algal genera, *Grateloupia* and *Sinotubimorpha*, and found that it was difficult to define an obvious distinction between the two genera based only on the morphological differences. Using the *rbcl* sequence analysis, *Sinotubimorpha* formed a single monophyletic subclade within the large *Grateloupia* clade of the Halymeniaceae (Sheng et al. 2012). It was, therefore, concluded that *Sinotubimorpha* should be retained in synonymy with *Grateloupia* where Wynne (2005) and Schneider and Wynne (2007) had placed it earlier based on the West Indian generitype of *Sinotubimorpha*, *Grateloupia porracea* Kütz.

***Pachymeniopsis*** Y. Yamada ex S. Kawabata 1954: 67.

Note: After being subsumed into *Grateloupia* by Kawaguchi (1997), Gargiulo et al. (2013) resurrected this genus from synonymy using reproductive and molecular data.

***Phyllymenia*** J. Agardh 1848: 47.

Note: In contrast to the merger of *Phyllymenia* with *Grateloupia* by De Clerck et al. (2005), Gargiulo et al. (2013)

resurrected this genus from synonymy using reproductive and molecular data.

**Prionitis** J. Agardh 1851: 185.

Note: Wang et al. (2001) proposed the merger of this genus into *Grateloupia*. Using reproductive and molecular data, Gargiulo et al. (2013) resurrected this genus from synonymy.

**Spongophloea** Huisman, De Clerck, Prud'homme et Borowitzka 2011: 12.

### Order Plocamiales

#### Family Plocamiaceae

**Plocamium** J.V. Lamour. 1813: 137. *nom. cons.*

Note: Cremades et al. (2011) investigated the type of *Plocamium cartilagineum* (L.) P.S. Dixon as well as the other original material of the European species of the genus, and they came to different conclusions than those reported by Saunders and Lehmkuhl (2005). This allowed for a taxonomic revision of the generitype and a better understanding of the other early named species of *Plocamium*.

### Order Sebdeniales

#### Family Sebdeniaceae

**Lesleigha** Kraft et G.W. Saunders 2011: 421.

### Order Rhodymeniales

#### Family Fryeellaceae

**Agardhinula** De Toni 1897: 64.

Note: Based upon the tetrasporangial ontogeny and characteristics, Saunders and McDonald (2010) and Schneider et al. (2012) suggested that this genus might possibly be a member of the Fryeellaceae, rather than the Rhodymeniaceae, where it had previously been placed.

#### Family Rhodymeniaceae

**Cresia** Losada-Troche et D.L. Ballant 2010: 296.

#### Incertae sedis generalis

**Lukinia** Perestenko 1996: 129, 203.

**Reingardia** Perestenko 1996: 129, 203.

Note: Because these two genera were first described directly after the treatment of the Phyllophoraceae (Gigartinales) in Perestenko (1996), we mistakenly attributed them to this family in our synoptic treatment of red algal genera (Schneider and Wynne 2007). It is unclear, at present, where they should be phylogenetically placed.

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