Molecular systematics of tropical Rhodymeniales (Rhodophyta) from Puerto Rico

by

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Abstract

The Rhodymeniales is one of twenty-four orders within the class Florideophyceae in the Division Rhodophyta. The application of molecular systematics to Rhodymeniales taxonomy has helped to recognize the order as a monophyletic group as well as clarify familial relationships within the order. Despite advances and the elucidation of phylogenetic relationships, there are genera whose taxonomic placement remains uncertain or their generic delimitation is not well defined. The present study addresses phylogenetic relations among rhodymenialean species reported from Puerto Rico using the small ribosomal subunit (18s) and the rubisco large subunit (*rbc*L) genes. Results from analyses of eighty-six 18s gene sequences highly supported all six families currently recognized within the order. In addition 18s sequence results have provided molecular evidence for the first time for inclusion of the genus *Chamaebotrys* within the *Erythrocolon* group in the family Rhodymeniaceae and supported the recognition of a new genus that based on morphological and reproductive characters was initially classified as a new *Chrysymenia* species. The new genus also belongs in the *Erythrocolon* group despite the possession of a non-septate thallus. Furthermore molecular data highly supported and provided evidence of the close phylogenetic relation between *Gloiocladia atlantica* (Searles) R.E. Norris and *Gloioderma fruticulosum* (Harv.) De Toni, which represent sister taxa. Nevertheless no formal transfer can be suggested because there is no molecular data available for *Gloioderma australis* (J. Agardh) R.E. Norris (the type species of the genus), to relate the species to either genus.

Sequences for both the 18s and *rbc*L genes confirm the polyphyletic nature of the genus *Chrysymenia*, revealing that *Chrysymenia enteromorpha* Harv. and *C. wrightii* (Harv.) Yamada are more closely related to the genus *Botryocladia* than to the other *Chrysymenia* species included in the analyses. Also data from the *rbc*L gene indicated that the recently described *Botryocladia iridescens* D.L. Ballant. *et* Ruiz is closely related to *B. madagascariensis* G. Feldmann. DNA sequence analyses from both genes highly supported the transfer of *Coelothrix irregularis* (Harv.) Børgesen to the Champiaceae despite some morphological and reproductive differences with members of the family, indicating that broadening of the defining characters of the family are needed. A new *Champia* species that superficially resembles *Champia parvula* (C. Agardh) Harv. was recognized. The new species can be distinguished externally on the bases of branch origin: between the septa in the new species and from the nodal region in the latter, and the number of axes arising from the holdfast. Analysis of 18s sequence and divergence indicated that *Chylocladia verticillata* (Lightf.) Bliding and *Gastroclonium ovatum* (Huds.) Papenfuss might be congeneric, nevertheless a larger species sampling is required prior to proposal of a formal transfer. Finally *rbc*L sequence analysis and divergence provided further evidence to maintain *Champia compressa* Harv. and *C. vieillardii* Kütz. as separate species.

Resumen

El orden Rhodymeniales es uno de los veinticuatro órdenes dentro de la clase Florideophyceae en la división Rhodophyta. La aplicación de la sistemática molecular a la taxonomía de los Rhodymeniales ha ayudado a reconocer este orden como un grupo monofilético, así como a elucidar las relaciones filogenéticas entre las familias dentro del orden. A pesar de los avances taxonómicos en las relaciones filogenéticas a nivel de familia existen géneros cuya posición taxonómica es incierta o su delimitación genérica no está bien definida. El presente estudio se enfoca en las relaciones filogenéticas entre las especies de rodimeniales reportadas para Puerto Rico utilizando los genes de la subunidad ribosomal pequeña (18s) y la subunidad grande del rubisco (*rbc*L). Los resultados del análisis de ochenta y seis secuencias del 18s altamente sustentan todas las seis familias aceptadas actualmente dentro del orden. Además, los resultados del 18s proveen evidencia molecular por primera vez para incluir el género *Chamaebotrys* dentro del grupo de *Erythrocolon* en la familia Rhodymeniaceae y respaldan el reconocimiento de un nuevo género que basado en las características morfológicas y reproductivas fue clasificado inicialmente como una nueva especie de *Chrysymenia*. El nuevo género también pertenece al grupo de *Erythrocolon* a pesar de poseer un talo no-septado. Además los datos moleculares sólidamente apoyan y proveen evidencia de la estrecha relación filogenética entre *Gloiocladia atlantica* (Searles) y *Gloioderma fruticulosum* (Harv.) De Toni siendo estas especies hermanas. No obstante, no se puede sugerir una transferencia formalmente por la falta de datos moleculares de *Gloioderma australis* (J. Agardh) R.E. Norris (la especie tipo del género) para relacionar las especies a cualquiera de los géneros.

Ambos genes el 18s y *rbc*L confirman la naturaleza polifilética del género *Chrysymenia*, revelando que *Chrysymenia enteromorpha* Harv. y *C. wrigthii* (Harv.) Yamada están más

relacionadas con el género *Botryocladia* que con otras especies de *Chrysymenia* incluidas en los análisis. También los datos del gene *rbc*L indicaron que la recientemente descrita *Botryocladia iridescens* D.L. Ballant. *et* Ruiz está más relacionada con *B. madagascariensis* G. Feldmann. El análisis de las secuencias de DNA de ambos genes altamente justifica la transferencia de *Coelothrix irregularis* (Harv.) Børgesen a la familia Champiaceae a pesar de algunas diferencias morfológicas y reproductivas con los miembros de esa familia, indicando que es necesario ampliar las características que definen la familia. Se ha reconocido una nueva especie de *Champia* que superficialmente se parece a *Champia parvula* (C. Agardh) Harv. La nueva especie puede distinguirse externamente usando como base el origen de las ramificaciones: entre los septos en la nueva especie y de la región nodular en *C. parvula* y el número de ejes que salen del anclaje. Los análisis de secuencias de 18s y la divergencia indican que *Gastroclonium ovatum* (Huds.) Papenfuss y *Chylocladia ovalis* (Hudson) Greville pueden ser congéneros, no obstante un mayor muestreo de especies es necesario antes de proponer una transferencia formal. Finalmente los análisis de secuencias de *rbc*L y su divergencia proveen evidencia adicional para mantener como especies separadas a *Champia compressa* Harv. y *C. vieillardii* Kutz.

Copyright

Dedication

This work is dedicated to my wife Sinthia Virella and my children Matthew, Aiden, James and the one waiting to be born.

You gave me the reason to succeed in the journey to achieve my academic goals.

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Chapter 1: Introduction

The Rhodophyta (red algae) are a group of marine and freshwater photosynthetic eukaryotes differing from other algal lineages in lacking flagella, storing food as floridean starch, possessing unique photosynthetic pigments and chloroplasts with single thylakoids. Red algae have a wide range of morphological expression, ranging from unicells to plants with parenchymatous construction (Gabrielson and Garbary, 1986). Among the earliest of eukaryotes (Gabrielson and Garbary, 1986; Saunders and Hommersand, 2004; Maggs *et al*., 2007), red algae are included in the kingdom Plantae, subkingdom Rhodoplantae, and division Rhodophyta. The division Rhodophyta currently includes 3 subphyla: Rhodellophytina, Metarhophytina and Eurhodophytina (Saunders and Hommersand, 2004). The subphylum Eurhodophytina includes two classes: Bangiophyceae and Florideophyceae. The Bangiophyceae is considered to be polyphyletic in nature, while the Florideophyceae is widely agreed to be monophyletic (Saunders and Kraft, 1997, Harper and Saunders, 2001).

The most widely utilized classification scheme for the Florideophyceae has been based almost exclusively on female reproductive anatomy and post-fertilization development (Schmitz, 1889; Kylin, 1956). Carposporophyte structure and post-fertilization development including the position of the auxiliary cell with respect to the procarp formed the basis of ordinal classification within the Florideophyceae: Nemalionales (currently known as Nemaliales), Gigartinales, Cryptonemiales, Rhodymeniales, Gelidiales and Ceramiales (Schmitz, 1889; Oltmanns, 1904; Kylin, 1956). The early 1980’s began what can be seen as a transition in algal taxonomy, shifting from a classical reproductive morphological approach to an integrated one that combined reproductive morphology, pit plug ultrastructure and molecular markers. This is evidenced with the discovery that pit plug structure possessed taxonomic significance at the ordinal level

(Pueschel and Cole, 1982). Their work provided further evidence to sustain segregation of the order Palmariales from the Rhodymeniales as well as providing additional support for the establishment of two new orders: Batrachospermales and Hildenbrandiales. Nevertheless many questions remained unanswered concerning overlapping of morphological characters among various orders. For example, the Cryptonemiales and Gigartinales had been recognized as two large heterogenous assemblages. Kraft and Robbins (1985) merged these based in part on recognition of ambiguity in interpretation of origin of the generative auxiliary cell in accessory vs normal vegetative position. Subsequent removal of several families to their own orders reduced the heterogeneity of former groups somewhat. These included elevation of families Corallinaceae, Hildenbrandiaceae, Ahnfeltiaceae, and Gracilariaceae on morphological and reproductive bases (Pueschel and Cole, 1982; Silva and Johansen, 1986; Maggs and Pueschel, 1989; Fredericq and Hommersand, 1989), and Plocamiaceae, Nemastomataceae, Acrosymphytaceae, and Sebdeniaceae to their own orders with the addition of molecular characters (Saunders and Kraft, 1994, 2002; Withall and Saunders, 2006). Despite the removal of these families the Gigartinales are still considered to be heterogenous and the Cryptonemiales is still recognized by some (Silva, 2002).

Recent concern has centered on whether the reproductive uniformity of the procarp and outward gonimoblast development of this group reflects a distinguishing character at the ordinal or familial rank and the overlapping of morphological characters between the Rhodymeniales and Gigartinales has raised doubts about the ordinal status of the former with respect to its phylogenetic position (Kraft and Robbins, 1985). Gabrielson and Garbary (1987) also questioned whether the Rhodymeniales merited ordinal status based on position of the auxiliary cell relative to the carpogonial branch, a feature shared with the Gigartinales. Questions about ordinal status of the Rhodymeniales persisted until Saunders and Kraft (1994, 1996) presented molecular evidence to support recognition of the Rhodymeniales as a distinct order from the Gigartinales.

Presently, the Rhodymeniales is now one of 24 orders currently included in the Florideophyceae (Maggs *et al*., 2007). The Rhodymeniales is considered to be a monophyletic order characterized by formation of an auxiliary cell before fertilization, *Polysiphonia*-type life history, pit plugs with no caps, solid or hollow thalli with or without medullary filaments, medullary gland cells, and tetrasporangia with cruciate or tetrahedral division (Saunders *et al*., 1999). Although the ordinal status of the order has been resolved, there remain a number of systematic difficulties concerning generic and familial placement. There are numerous examples within the Rhodymeniales for which the molecular data do not confirm classic morphologically based criteria. For example, the morphological characters that separate genera such as *Botryocladia* and *Chrysymenia* are currently being questioned with the recognition that these genera are not monophyletic and represent heterogeneous assemblages (Saunders *et al*., 1999; Afonso-Carrillo and Sobrino, 2003; Gavio and Fredericq, 2005; Wilkes *et al*., 2006). Systematic incongruencies within the Rhodymeniales as a whole have been well documented (Saunders and Kraft, 1994, 1996; Huisman, 1995, 1996; Saunders, 2004). The recognition of the genus *Irvinea* erected by Saunders *et al*. (1999) based on *Botryocladia ardreana* J.Brodie *et* Guiry (1988) clearly illustrates this problem. *Botryocladia ardreana* was originally recognized as being an unusual species and was characterized by cortical cells arranged in a rosette pattern, anatomically distinct cell bearing gland cells and strongly protuberant cystocarps. Generic segregation from *Botryocladia* was justified by Saunders *et al*. (1999) despite the fact that all of these morphological features are shared with some *Botryocladia* species, because *B. ardreana* did not clade with other *Botryocladia* species included in their 18s molecular analysis. Thus as presently recognized, *Irvinea* is only identifiable by DNA sequences (Afonso-Carrillo *et al.*, 2006; Ballantine and Ruíz, 2008). Wilkes *et al*. (2006) later transferred *Botryocladia boergesenii* Feldman to *Irvinea* also on DNA sequences. The character of branched (*Irvinea*) vs unbranched (*Botryocladia*) vesicles as a distinguishing character was also introduced by Wilkes *et al*. (2006); however, bifurcate vesicles are also present in *B. adhaerens* E.Y.Dawson (Ballantine and Ruíz, 2008).

In recent years, a number of new Rhodymeniales species have been recognized. Many of these new species have come from sub-tropical and tropical regions of the western Atlantic. For example since 1980, at least ten new species have been described from the Caribbean region alone, including *Botryocladia wynnei* D.L.Ballant. (1985), *B. bahamense* D.L.Ballant. *et* Aponte (2002a), *B. caraibica* Gavio *et* Fredericq (2003), *B. ballantinei* Gavio *et* Fredericq (2005), *B. iridescens* D.L.Ballant. *et* Ruíz (2008), *Champia harveyana* D.L.Ballant. *et* Lozada-Troche (2008), *Chylocladia schneideri* D.L.Ballant. (2004), *Chrysymenia nodulosa* J.N.Norris *et* D.L.Ballant. (1995), *C. littleriana* J.N.Norris *et* D.L.Ballant. (1995) and *Halichrysis corallinarius* D.L. Ballant. *et al*. (2007). Schneider and Lane (2008) more recently described three new *Botryocladia* species from the Bermudas including: *B. bermudana* Schneider *et* Lane, *B. exquisita* Schneider *et* Lane, and *B. flookii* Schneider *et* Lane.

The main purpose of this study was to examine phylogenetic relationships of algae belonging to the order Rhodymeniales reported from Puerto Rico. Phylogenetic relationships were addressed by examining morphological characters and DNA sequences from small ribosomal subunit (18s) and Ribulose-1,5-bisphosphate carboxylase/oxygenase (rubisco) large subunit (*rbc*L) genes.

Chapter 2: Literature Review

The Rhodymeniales, one of the four original orders of red algae proposed by Schmitz (1889), based on the patterns of zygote formation and development, initially included 6 families: Spharococcaceae, Rhodymeniaceae, Bonnemaisoniaceae, Delesseriaceae, Rhodomeleaceae and Ceramiaceae. Oltmans (1904) separated the families Delesseriaceae, Rhodomelaceae and Ceramiaceae to the Ceramiales which included species in which the auxiliary cell forms after fertilization. Sjostedt (1926) elevated the family Sphaerococcaceae to the order Sphaerococcales. However, Kylin (1928) considered the Sphaerococcaceae to be a family within the Gigartinales and also placed the Bonnemaisoniaceae in the Nemaliales (as Nemalionales). These changes left the Rhodymeniales with a single family, the Rhodymeniaceae, defined by having auxiliary cells formed prior to fertilization. These auxiliary cells are borne laterally as one- or two-celled filaments on the supporting cell. The family Rhodymeniaceae as described by Schmitz (1889) included two subfamilies (Gloiocladiodeae and Rhodymenioideae).

Bliding (1928) divided the Rhodymeniaceae, creating a new family, the Champiaceae, defined by a hollow thallus structure with peripheral longitudinal filaments, 4-celled carpogonial branches and tetrahedrally divided tetrasporangia. Kylin (1931) erected subfamilies Faucheae (equivalent to Schmitz's Gloiocladiodeae), Hymenocladieae, and Rhodymenieae (Schmitz's Rhodymenioideae) within the family Rhodymeniaceae on the basis of carpogonial branch cell number, presence or absence of a "tela arachnoidea", and tetrasporangial position and division pattern. The Faucheae and Rhodymenieae both possessed cruciately divided terminal tetrasporangia. They were distinguished from each other by the presence of "tela arachnoidea" in the cystocarp in the former and its absence in the latter. In contrast, the Hymeniocladieae was characterized by the presence of intercalary tetrasporangia with a tetrahedral cleavage pattern and absence of “tela arachnoidea”. In addition, Kylin (1931) proposed subfamilies Champieae and added Lomentarieae within the family Champiaceae.

Kylin’s (1956) final treatment of the Rhodymeniales included only the families Rhodymeniaceae and Lomentariaceae (Bliding’s Champiaceae) while abandoning the designation of subfamilies. Instead he split the families recognized at the time into informal groups (“Gruppen”). The *Champia* and *Lomentaria* groups were part of the family Lomentariaceae. The Rhodymeniaceae was divided into six informal groups: *Fauchea*, *Hymenocladia*, *Botryocladia*, *Chrysymenia*, *Erythrocolon* and *Rhodymenia*.

Sparling’s (1957) monograph maintained Bliding’s and Kylin’s families (Rhodymeniaceae and Champiaceae), but rejected the criteria used by Kylin (1931) that divided the Rhodymeniaceae into three subfamilies. She proposed placement of species with hollow thalli and longitudinal medullary filaments in the Champiaceae, while the Rhodymeniaceae included species without such filaments, and only recognized the subfamilies Rhodymenieae and Hymenocladieae within the family Rhodymeniaceae from Kylin’s (1931) scheme. Sparling rejected the subfamily Faucheae, in which the cystocarp is surrounded by a “tela arachnoidea”, as this was the only distinction between Faucheaceae and the Rhodymenieae. The “tela arachnoidea” is formed as a result of the gradual stretching apart of the cells of the pericarp as they start arching outwardly during development (Sparling, 1957). Sparling felt that this character was too variable to have taxonomic value and was not sufficient to characterize a separate subfamily. The subfamily Hymenocladieae was distinguished by tetrahedral tetrasporangial division, while the Rhodymenieae had terminal cruciate tetrasporangia. At this early date, Sparling recognized and demonstrated that some reproductive features may be common to both families. Nevertheless, only solid thallus Rhodymeniales species were examined. Thus, questions remained about the phylogenetic position of the hollow Rhodymeniaceae.

Until 1974, *Rhodymenia palmata* (L.) Grev. was the generitype of the genus *Rhodymenia*. Comparative studies on anatomy and reproduction of *R. palmata* showed that the species was not congeneric with *Rhodymenia pseudopalmata* (J.V. Lamour.) P.C. Silva. Morphological characters of *R. palmata* indicated instead a close relationship with *Halosaccion*, however sufficient differences were observed to justify placing the former in a separate genus. Guiry (1974) on the basis of these observations transferred *R. palmata* to the genus *Palmaria*. *Palmaria palmata* (L.) Kuntze differs from other *Rhodymenia* species in having heteromorphic alternation of generations in which the female is highly reduced and sporophytes possess generative tetrasporangial mother cells. Based on morphological differences with other Rhodymeniaceae members, Guiry (1974) created the family Palmariaceae to include *Palmaria* along with *Halosaccion* and *Leptosarca.* He provisionally retained the family within the order Rhodymeniales because no carpogonia or carposporophytes had been described at the time. Later, Guiry and Irvine (1981) formally proposed segregation of the Palmariaceae to the order Palmariales. Pit plug ultrastructure studies by Pueschel and Cole (1982) provided futher evidence to support segregation of Palmariales as a separate order from the Rhodymeniales. All members of the Palmariales possess a two layered pit plug cap, while the Rhodymeniales have a naked plug cap (Pueschel and Cole, 1982).

Lee (1978) in a later monographic treatment of the Rhodymeniales followed Kylin’s subfamilies (Rhodymenieae and Hymenocladieae) within the Rhodymeniaceae, but disagreed with inclusion of the subfamily Lomentariae in the Champiaceae, elevating the Lomentarieae to familial status, Lomentariaceae. The Lomentariaceae was separated from the Champiaceae on the basis of lack of thallus septation, three-celled carpogonial branch and terminal tetrasporangial position. This three-family classification system was widely accepted (including West and Hommersand, 1981; Wynne and Kraft, 1981, Womersley, 1996).

Early molecular-based research in algae as a whole included limited molecular data for the Rhodymeniales, yet the early data sets provided evidence to indicate monophyly for the order (Saunders and Kraft, 1994, 1996). Saunders *et al*. (1999) treatment of the Rhodymeniales based on 18s sequence analysis provided insights on phylogenetically relevant morphological features. For example characters related to the vegetative morphological structure such as thallus construction (hollow or solid) and the presence or absence of medullary filaments were inconsistent with molecular placement. On the other hand, reproductive features such as carpogonial branch cell number, and tetrasporangial position and cleavage pattern were consistent with molecular placement, hence considered more important for classification. On these bases, the defining characters of each family were emended. Furthermore, 18s sequence analysis provided sufficient proof to remove Kylin's *Fauchea* group from the Rhodymeniaceae to its own family Faucheaceae (Saunders *et al*., 1999). The family was moderately supported as monophyletic and included the genera *Fauchea*, *Faucheopsis*, *Gloioderma* and *Webervanbossea*. Despite these taxonomic advances, the relationships among the major lineages in the Rhodymeniales remained unresolved until Le Gall *et al*. (2008) described two new families: the Hymenocladiaceae and the Fryeellaceae. The new families were erected on the bases of reproductive structures, tetrasporangial features and molecular evidence from the large ribosomal subunit gene (28s). Thus the current families within the Rhodymeniales are: Champiaceae, Faucheaceae, Lomentariaceae, Rhodymeniaceae, Hymenocladiaceae, and Fryeellaceae (Saunders *et al*., 1999; Le Gall *et al*., 2008). These are distinguished primarily on number of cells in the carpogonial branch, tetrasporangial division pattern and position (Table 1). A summary of taxonomic changes at the familial and subfamilial level for the Rhodymeniales from Kylin (1931) to Le Gall *et al*. (2008) is given in Table 2.

Correct taxonomic placement of the genus *Dictyothamnion* within the order Rhodymeniales also resulted from the inclusion of molecular sequence analyses. When Millar (1990) described *Dictyothamnion*, he was hesitant to assign it to family due to the fact that the genus had morphological characters in common with the Champiaceae and Lomentariaceae. Morphological similarities with Champiaceae included longitudinal filaments producing gland cells (also present in Lomentariaceae), intercalary tetrahedrally divided tetrasporangia originating from the cortex, a well developed “tela arachnoidea”, and dichotomously branched gonimoblast filaments bearing 2-3 terminal carposporangia. The presence of multilayered septa in *D. saltatum* A.Millar suggested a close taxonomic affinity with members included in the Champiaceae. Subsequently, Saunders *et al*. (1999) included *D. saltatum* in a molecular survey using 18s sequences and provided evidence to assign the species in the Champiaceae, positioning the species at the base of the family.

The taxonomic affiliation of *Gelidiopsis* and *Ceratodictyon* further illustrates the contribution of molecular based approaches to Rhodymeniales taxonomic issues. Both genera were assigned to the Gracilariaceae by Kylin (1956). Norris (1987) proposed merging *Gelidiopsis* into *Ceratodictyon* on the basis of vegetative similarities such as thallus shape, small-celled outer cortex, pseudoparenchymatous medulla and cystocarp structure. Later, Price and Kraft (1991) suggested that they be maintained as distinct genera and transferred both to the Rhodymeniaceae. Their conclusion was based on procarp organization, carposporangial disposition, pericarp structure and possession of decussate cruciately divided tetrasporangia.

Table 1 Principal reproductive characters that distinguish the current families accepted within the Rhodymeniales based on Le Gall *et al*. (2008).

Character	Champiaceae	Lomentariaceae	Faucheaceae	Rhodymeniaceae	Hymenocladiaceae	Fryeellaceae
Tetrasporangial division	Tetrahedral	Tetrahedral	Cruciate	Cruciate	Tetrahedral or cruciate	Tetrahedral or cruciate
Tetrasporangial position	Intercalary	Terminal	Terminal	Intercalary, rarely terminal	Intercalary	Terminal
Carpogonial branch	4 cells	3 cells	3 cells	4 cells	4 cells	3 cells

Table 2 Major familial and subfamilial changes in Rhodymeniales taxonomy since Kylin 1931.

Kylin (1931)	Kylin (1956)	Guiry (1974)	Lee (1978)	Saunders *et al*. (1999)	Le Gall *et al*. (2008)
Champiaceae	Lomentariaceae	Champiaceae	Champiaceae	Champiaceae	Champiaceae
Champieae	*Champia* group	Rhodymeniaceae	Lomentariaceae	Lomentariaceae	Lomentariaceae
Lomentarieae	*Lomentaria* group	Palmariaceae[1]	Rhodymeniaceae	Rhodymeniaceae	Rhodymeniaceae
Rhodymeniaceae	Rhodymeniaceae		Hymenocladiae	Faucheaceae	Faucheaceae
Faucheae	*Fauchea* group		Rhodymeniae		Hymenocladiaceae
Hymenocladiae	*Hymenocladia* group				Fryeellaceae
Rhodymeniae	*Rhodymenia* group				
	Botryocladia group				
	Chrysymenia group				
	Erythrocolon group				

[1]The Palmariaceae was later included in the new order Palmariales (Guiry and Irvine, 1981).

Furthermore, *Gelidiopsis* and *Ceratodictyon* produce tetrasporangia in nemathecia, a character also present in some members of the Rhodymeniaceae. Subsequently, Saunders *et al*. (1999) transferred *Ceratodictyon* and *Gelidiopsis* to the Lomentariaceae despite the possession of solid thalli and cruciately divided tetrasporangia. The inclusion of both genera within the Lomentariaceae was supported by possession of a typical lomentariacean fusion cell and 18s sequence analyses (Price and Kraft, 1991; Saunders *et al*., 1999). Saunders *et al*. (1999) considered that the addition of these genera within the Lomentariaceae represented a reversion to the ancestral tetrasporangial state (tetrasporangia cruciately divided rather than tetrahedral). Evolutionary character reversal has also been reported in other Rhodymeniales species as well (Saunders *et al*., 1999). The molecular evidence also provisionally indicated that the two genera were different (Saunders *et al*., 1999, *op. cit*.). The most recent molecular-based treatment of Rhodymeniales by Le Gall *et al*. (2008) based on sequences from the large ribosomal subunit (28s) supported Norris´s hypothesis and proposed the combinations *Ceratodictyon intricatum* and *C. variabile* for species previously known as *Gelidiopsis intricata* (C. Agardh) Vickers and *Gelidiopsis variabilis* (J. Agardh) Schmitz, respectively.

Recently the taxonomic position within the Rhodymeniales for *Erythrymenia*, *Hymenocladia*, *Fryeella*, *Coelothrix* and *Hymenocladiopsis* were clarified using reproductive characters and molecular data from the 28s gene (Le Gall *et al*., 2008). *Erythrymenia*, *Hymenocladia* and *Asteromenia* were included in the new family Hymenocladiaceae characterized by 3-celled carpogonial branches, intercalary disposition of tetrasporangia and tetrasporangial division being either tetrahedral or cruciate. On the other hand, *Fryeella* and *Hymenocladiopsis* are members of the new family Fryeellaceae defined by 4-celled carpogonial branches, terminally placed tetrasporangia with either tetrahedral or cruciate division. The genus

Coelothrix was also recently transferred from the Rhodymeniaceae to the Champiaceae on the basis of morphological and reproductive similarities with members of the latter family. The molecular evidence indicated that the genus represents a sister taxon of *Chylocladia* and the recently described genus *Neogastroclonium* (Le Gall *et al*., 2008)

As previously mentioned, there are some genera within the Rhodymeniales that remain problematic. These include *Botryocladia*, and *Chrysymenia* and C*hamaebotrys* among others. The segregation of *Botryocladia* and *Chrysymenia* is based on simple morphological criteria that have recently been questioned with the recognition that they are not monophyletic and represent heterogeneous groups (Saunders *et al*., 1999; Afonso-Carrillo and Sobrino, 2003; Gavio and Fredericq, 2005; Wilkes *et al*., 2006). The genus *Chamaebotrys* was segregated from *Coelartrum* by Huisman (1996) on the basis of terminal cruciately divided tetrasporangia that are produced in nemathecia. These reproductive characters suggested that the species should be included in the Faucheaceae rather than the Rhodymeniaceae; however the lack of molecular evidence to sustain this contention made the classification uncertain. However Saunders *et al*. (1999) provisionally assigned the genus to the Rhodymeniaceae, considering that a reversion to the ancestral condition of terminal tetrasporangia had occurred in *Chamaebotrys*.

The entity known as *Asteronemia peltata* (W.R.Taylor) Huisman *et* A.Millar has had an interesting taxonomic history. This species was originally described from Venezuela as *Fauchea peltata* W.R.Taylor (1942). Schneider (1975) on the bases of reproductive morphology concluded that it was misplaced in the genus *Fauchea*, and transferred the species to *Weberella*. Later, Huvé and Huvé (1977) transferred *Weberella* to *Halichrysis*. This treatment was accepted until Huisman and Millar (1996) completed a detailed anatomical examination and concluded that the species did not belong to any of the previous generic assignments and erected the monospecific genus *Asteromenia* for *Fauchea peltata*. Subsequent molecular analysis of 18s sequences demostrated that *Asteromenia* and *Fauchea* were in fact different entities (Saunders *et al*. 1999). Freshwater's (2005) molecular analysis of specimens identified as *Asteromenia peltata* (W.R.Taylor) Huisman *et* A.Millar from different regions indicated that Atlantic (Bermuda and North Carolina) and Western Australian specimens represented different species. The Western Australian taxon was well resolved within the Rhodymeniaceae, while the Bermuda and North Carolina specimens were resolved in a clade that was not part of any currently recognized family. Furthermore, sequence divergence from Bermuda and North Carolina specimens referable to *A. peltata* indicated that they represented different species.

Ultimately, Saunders *et al*. (2006) on the basis of 18s and large ribosomal subunit (28s) gene sequences decided that *Asteromenia peltata sensu lato* constituted a complex of at least five species. *Asteromenia peltata* and *A. bermudensis* G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft (2006) were restricted to the Western Atlantic. Specimens from Western Australia were described as new species: *A. anastomosans* G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft (2006), *A. examinans* G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft (2006), and *A. pseudocoalescens* G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft (2006). The authors also concluded that *Asteromenia*, *Drouetia* and *Halychrisis* should be maintained as distinct genera. As previously mentioned *Asteromenia* is currently classified in the new rhodymenialean family Hymenocladiaceae (Le Gall *et al*., 2008).

Rodríguez-Prieto *et al*. (2007) studied vegetative and reproductive morphology plus applied molecular data to *Fauchea repens* C. Agardh and *Gloiocladia furcata* (C. Agardh) J. Agardh. They indicated that the two species were closely related and should be considered to be congeneric. Thus they proposed transfer of *Fauchea repens* to *Gloiocladia repens* (C. Agardh)

Sánchez *et* Rodriguez-Prieto, and transferred the remaining *Fauchea* species to *Gloiocladia* as well. Molecular data indicated that *Gloioderma fruticulosum* (Harv.) De Toni represented a sister clade of *Gloiocladia* spp. and *Faucheopsis coronata* (Harv.) Kylin. On this basis they reinstated the genus *Gloioderma*, which had been considered to be congeneric with *Gloiocladia* (Norris, 1991).

Plastid DNA, specifically the rubisco large subunit (*rbc*L) gene, has also been utilized in Rhodymeniales phylogenetic studies. Freshwater and Rueness (1994) considered the *rbc*L gene to be appropriate for phylogenetic studies because of its a) large size, approximately 1,400 base pairs (bp), b) relative slow rate of evolution, and c) availability of conserved primers for DNA amplification and sequencing. Sequences of *rbc*L have been used to study Rhodophyta ordinal phylogenetic relationships (Freshwater *et al*., 1994), as well as specific orders including Batrachospermales (Vis *et al*., 1998), Gelidiales (Bailey and Freshwater, 1997; Freshwater and Rueness, 1994) and Gracilariales (Gurgel and Fredericq, 2004). Sequences of *rbc*L have also being analyzed in the families Delesseriaceae (Lin *et al*., 2001), Gigartinaceae (Hughey *et al*., 2001) and Solieriaceae (Fredericq *et al*., 1999).

Gavio and Fredericq (2005) made the first extensive study of the Rhodymeniales species of the Northern Gulf of Mexico combining morphology and *rbc*L sequences. They described four species as inferred from their analyses: *Botryocladia ballantinei* Gavio *et* Fredericq, *Gloiocladia pelicana* Gavio *et* Fredericq, *Gloiocladia tenuissima* Gavio *et* Fredericq, and *Leptofauchea earleae* Gavio *et* Fredericq. The last proved to be improperly assigned to genus as it was not supported by subsequent *rbc*L sequence analysis (Dalen and Saunders, 2007).

Gavio and Fredericq (2005) also questioned the suggestion made by Saunders *et al*. (1999) that the genus *Halichrysis* might belong in the Faucheaceae. Their *rbc*L results indicated that the genus nested within the Rhodymeniaceae. A subsequent *Halichrysis* molecular study by Saunders *et al*. (2006) provided further evidence that this genus belonged in the Rhodymeniaceae. The Gavio and Fredericq (2005) study also indicated that *Fryeella* and *Hymenocladiopsis* form a clade, separate from any of the recognized families within the order, in accordance with Saunders´ *et al*. (1999) previous 18s molecular survey of the Rhodymeniales.

Another interesting example of Rhodymeniales taxonomical confusion based on simple gross morphology regards *Botryocladia caraibica* Gavio *et* Fredericq (2003). This species was described from the Caribbean Sea, but had been previously reported as *B. pyriformis* (Børgesen) Kylin. The new species can be differentiated from *B. pyriformis* on the morphological bases of gradual transition between cortex and medulla, 3-5 cell wall layers and complete cortication in the former. Analysis of *rbc*L sequences demonstrated that *B. caraibica* is a sister taxon of *B. monoica* Schnetter, clading separately from the morphologically similar *B. pyriformis*, which turns out to be a sister taxon to *B. occidentalis* (Børgesen) Kylin.

Another systematic difficulty among the Rhodymeniales (in addition to other Florideophyceae) concerns the brevity of original descriptions as well as recognition of boundaries between species that have similar morphology. An example of this problem is illustrated by Ballantine and Lozada-Troche (2008). They described *Champia harveyana* D.L.Ballant. *et* Lozada-Troche, which bears a close morphological similarity to *Champia salicornioides* Harv. The new species shared a number of features with *C. salicornioides* including general size and appearance, branching pattern, conspicuous similarly shaped and sized cystocarps, carposporangia and tetrasporangia. The two species are externally differentiated with respect branching origin: between the nodal septa in *C. salicornioides* and from the septal region in *C. harveyana*. Their segregation was supported by *rbc*L data indicating a 2.5 to 3.1% divergence. *Champia harveyana* is probably conspecific with *Chrysymenia subverticillata* P.Crouan *et* H.Crouan, a name considered as being synonymous with *C. salicornioides* by Taylor (1960) and also as a *nomen subnudum* by Silva (1997-2004). The protologue for *C. subverticillata* consisted of a little more than a brief characterization of color, insufficient to separate it from even from other *Chrysymenia* species (the genus that the species was then referred to) listed in Mazé and Schramm (1878). The question of taxonomic status for *nomen subnudum* will probably remain controversial; however, the authors argued for erecting a new taxon rather than validating the name *C. subverticillata*.

Although many new species within the order have been documented in recent years and taxa regrouped to reflect natural relationships, it is evident that much work still is needed. There are many genera within the order that still require detailed molecular based studies including *Agardhinula*, *Binghamia*, *Binghamiopsis*, *Cenacrum*, *Cryptarachne* and *Chamaebotrys* among others.

Chapter 3: General Methodology

Collection and Morphological Examination

Algae (Table 3) were collected either by snorkeling or SCUBA at various locations around the island (Figure 1) (Appendix 1). Algal species were preserved in 10% formalin for morphological study. Transections (25-40 µm thick) were made using an American Optical Cryo-Cut freezing or a Leica CM1850 Cryostat microtome. Microscopic preparations were stained in acidified 1% aniline blue and mounted in 60% Karo® corn syrup on microscope slides. Photomicrographs were taken with a SPOT RE digital camera through an Olympus BMAX light microscope. Herbarium abbreviations follow Holmgren *et* al. (1990) and authority designations are according to Brummitt and Powell (1992). Voucher specimens were deposited at the Herbario Marino Puertoriqueño (MSM).

Fig. 1 Map showing collections sites (marked by red stars) around Puerto Rico.

Table 3 Rhodymeniales species reported from Puerto Rico (Ballantine and Aponte, 2002b).

Family Champiaceae *Champia harveyana* D.L.Ballant. *et* Lozada-Troche* *C. parvula* (C. Agardh) Harv.* *C. salicornioides* Harv.* *C. vieillardii* Kütz.* *Champiocolax sarae* Bula-Meyer *Chylocladia schneideri* D.L. Ballant.*	**Family Faucheaceae** *Gloiocladia atlantica* (Searles) R.E.Norris *
Family Lomentariaceae *Gelidiopsis planicaulis* (W.R.Taylor) W.R.Taylor *Lomentaria baileyana* (Harv.) Farl.* *L. rawitscheri* A.B.Joly* **Family Hymenocladiaceae** *Asteromenia peltata* (W.R.Taylor) Huisman *et* A.Millar *A. bermudensis* G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft	**Family Rhodymeniaceae** *Botryocladia iridescens* D.L.Ballantine *et* Ruíz* *B. occidentalis* (Børgesen) Kylin * *B. pyriformis* (Børgesen) Kylin *B. shanksii* E.Y.Dawson *B. spinulifera* W.R.Taylor *et* I.A.Abbott * *B. wynnei* D.L.Ballant. * *Chrysymenia agardhii* Harv.* [1] *C. enteromorpha* Harv. * *C. halymenioides* Harv. *C. nodulosa* J.N.Norris *et* D.L.Ballant.* *Coelarthrum cliftonii* (Harv.) Kylin* *Coelothrix irregularis* (Harv.) Børgesen* *Chamaebotrys* sp.* *Halichrysis corallinarius* D.L.Ballant., G.W. Saunders *et* H.Ruíz *Maripelta atlantica* Eiseman *et* R.L. Moe *Rhodymenia divaricata* E.Y.Dawson*

* Species included in this study. [1] Previously known from Puerto Rico as *Chrysymenia planifrons* (Ballantine and Aponte, 2002b), this taxon is treated herein as *C. agardhii*.

DNA extraction

Specimens were dried in silica gel for DNA molecular studies (Chase and Hills, 1991). Total genomic DNA was isolated using a combination of the protocols described by Saunders (1993) and Aras *et al*. (2003). Approximately 15 mg of algal tissue were disrupted by grinding in liquid nitrogen. The sample was incubated for 40 minutes (min) at 37^0C and another 10 min at

65^0C in 600 μl of lysis buffer (100 mM Tris HCl, 50 mM EDTA, 1.4 M NaCl, 2% CTAB, 1% PVPP-40). Fifteen microliters of Proteinase K (20 mg/ml) (Saunders, 1993) were added prior incubation. Polysaccharides were precipitated by adding 300 μl of 5M potassium acetate and incubated on ice for 30 min. Samples were centrifuged for 8 minutes at 14K RPM. The supernatant was collected and proteins were denatured and extracted with 700 μl of phenol:chloroform:isoamyl alcohol (25:24:1). Samples were spun for 6 min at 14K RPM and the supernatant was collected. The DNA was precipitated by overnight incubation in 100% isopropanol. After precipitation, samples were centrifuged for 8 min at 14K RPM. The DNA pellet was washed with 70% ethanol, dried in an Eppendorf Vacufuge™ (Brinkmann Instruments, Westbury, USA) and the residue dissolved in 15-40 μl of 10 Mm Tris. Genomic DNA was visualized in 1% agarose gel stained with ethidium bromide (10 mg/ml) (Sambrook *et al*., 1989).

DNA amplification

Polymerase Chain Reaction (PCR) was used to amplify the 18s gene (Figure 2)(White *et al*., 1989) using the primer combination G01-G14, G04-G07 and G03-G08 (Figure 3) (Saunders and Kraft, 1994). The rubisco large subunit (*rbc*L) was amplified with PCR using the primers F8 (5'-GGTGAATTCCATACGCTAAAATG-3') (forward) and R1381 (5'-ATCTTTCCATAAATCTAAAGC-3') (reverse) (Figure 4) (Wang *et al*., 2000).

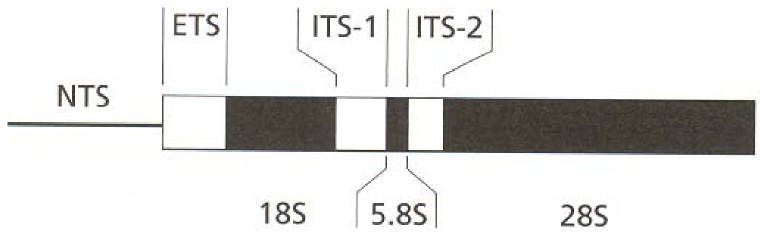

Fig. 2 Typical eukaryotic ribosomal DNA array. The ribosomal genes are 18S, 5.8S and 28S. (NTS= non transcribed spacer, ITS= internal transcribed spacer 1 and 2, ETS= external transcribed spacer) (Page and Holmes, 1998).

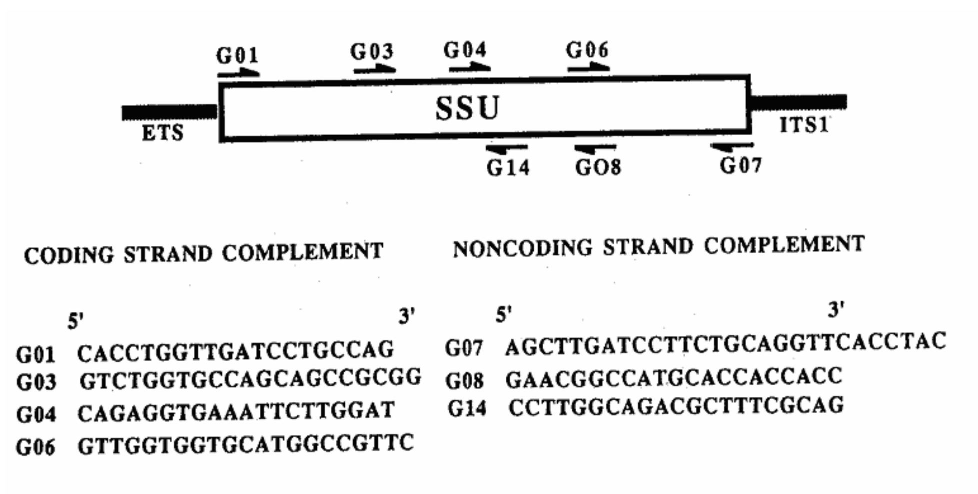

Fig. 3 Small ribosomal subunit (SSU) red algal primers used in this study, their sequence and orientation (represented by the arrows) (Saunders and Kraft, 1994).

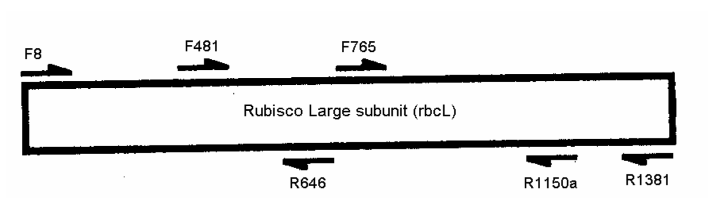

Fig. 4 Map showing location and orientation (represented by the arrows) of *rbc*L primers used for PCR amplification and sequencing. *rbc*L= Ribulose-1,5-bisphosphate carboxylase/oxygenase (rubisco) large subunit.

PCR amplifications were carried out in 200 μl microtubes, in a total volume of 50 μl containing 2.5 μM of nucleotide mix, 20-30 pmol of each primer, 2.5 Units of Taq Polymerase (Promega, Madison, WI), 1X reaction buffer and 20-50 ng of genomic DNA. Amplifications were performed in an Eppendorf Master Cycler® gradient (Brinkmann Instruments) using 30 cycles with the following parameters: 1 min denaturation @ 94°C, 45 sec annealing @ 45°C, 1 min extension @ 72°C, and a final extension of 5 min @ 72°C. PCR amplification were verified using a 1% agarose gel with ethidium bromide 10mg/ml) under UV light (Sambrook *et al*., 1989). Length of amplified fragments was determined by comparison with the migration of Lambda Hind III plus marker (Lambda Biotech Inc., St. Louis, USA). PCR products were purified for sequencing reactions using the Eppendorf Perfectprep® Gel Cleanup Kit (Brinkmann Instruments).

DNA sequencing

The sense and reverse strands of the PCR products of the Rhodophyta strains were sequenced using the Applied Biosystems Big Dye™ Terminator v3.1 and ABI 3130 xl genetic analyzer (Applied Biosystems/ MDS SCIEX, Foster City, USA). Additional primers for 18S sequencing include G03, G06, and G08 (Figure 2). For *rbc*L sequencing additional primers F481 (5'-GTAGAACGTGAGCGTATGGA-3'), F765 (5'-TGAAAGAGCTGAATTTGCTAA-3'), R646 (5'-AATCTTTCTTTCCAACGCAT-3') and R1150a (5'-GCATTTGTCCGCAGTGAATACC-3') (Figure 4) were used (Wang *et al*, 2000). The sequencing reaction consisted of sequencing reaction reagent, Big Dye terminator reaction buffer, 50-70 ng of PCR product, 10 pmol of forward or reverse primer for 18S and *rbc*L, and dH_20 in a total volume of 10 μl. Sequencing was carried out at the Genotyping facility, University of Puerto Rico-Río Piedras. DNA sequences were edited and assembled using Sequencher (Gene Codes Corp, Ann Arbor, MI, USA) and aligned with CLUSTALX (Thompson *et al*., 1997) (Appendix 2 and 3). Following publication, all sequences generated will be deposited in GenBank.

Phylogenetic Reconstruction

The phylogenetic reconstruction was performed using the maximum parsimony (MP), neighbor joining (NJ), and maximum likelihood (ML) algorithms as implemented in PAUP* (Swofford, 2002). Bayesian Inference was determined with Mr.Bayes (v.3.1.2) (Hueselbeck and Ronquist, 2001). Modeltest (Posada and Crandall, 1998) was used to determine the correct DNA substitution model to be used as input for NJ and ML analysis as calculated by the Akaike information criterion (AIC) (Akaike, 1974) and Bayesian Information Criterion (Schwarz, 1974). The robustness of the data was determined by bootstrapping the data set (Felsenstein, 1985) 100 times for ML and 2,000 times for MP and NJ. Bayesian analysis was conducted running a minimum of 1,000,000 generations. Trees were sampled every 100 generations to verify when the log-likelihood scores stabilized to determined trees to be discarded as burn-in. *Sebdenia flabellata*, *Halymenia floresii* and *H. plana* were used as outgroups in phylogenetic reconstruction because they represent sister taxa of the order Rhodymeniales (Saunders and Kraft, 1996).

Chapter 4: Taxonomic affiliation of *Coelothrix irregularis* (Rhodymeniales, Rhodophyta) based on molecular data analysis

Summary – *Coelothrix irregularis* (Harv.) Børgesen, until recently a member of the Rhodymeniaceae, has had several familial assignments within the Rhodymeniales. While suggested by some that the genus belonged in the Champiaceae on the basis of morphological characters, the transfer of the genus to that family has only recently been made and that effected on the basis of molecular evidence. Additional morphological characters for the species as well as DNA sequence analyses from 18s and *rbc*L genes further support the placement of *Coelothrix* in the Champiaceae rather than the Rhodymeniaceae. *Coelothrix* represents a sister taxon of the genera *Chylocladia* spp., *Gastroclonium ovatum* and *Neogastroclonium* with moderate to highly supported bootstrap values and posterior probabilities for all optimality criteria tested. Tetrasporangial division in Puerto Rican plants appears to be principally decussate cruciate, which is in contrast with most accounts for the species.

Introduction

The genus *Cordylecladia* J.Agardh (1852) was originally assigned to the Rhodymeniaceae; although Greville (1930), Kylin (1930, 1956) and Jones (1957, 1962) considered the type species of the genus, *C. erecta* (Greville) J. Agardh, to be a species of *Gracilaria*, *G. erecta* (Greville) Greville. Feldmann (1967) detailed the vegetative structure and cystocarp development in *C. erecta* and concluded that the original placement of the genus in the Rhodymeniaceae was correct. The genus currently includes *C. erecta* and *C. guiryi* Gargiulo, G. Furnari *et* Cormaci (Gargiulo *et al.*, 1991). Another species, *Cordylecladia irregularis* Harv., was added by Harvey (1853) with assignment to the genus made on the bases of vegetative similarities including a hollow thallus with irregular branching pattern and internal anatomy with a single row of cortical cells to the exterior of several rows of medullary cells which increase in size towards the center of the axes (Harvey, 1853). Species inclusion in the genus *Cordylecladia* was made with hesitation because no reproductive structures were observed. The medulla is composed of large pseudoparenchymatous cells covered by 2-3 layers of small cortical cells (Brodie and Guiry, 1988b). Reproductively, *Cordylecladia* possesses cystocarps with carpostomes and intercalary cruciately divided (Brodie and Guiry, 1988b). Morphological and reproductive features of both *C. erecta* and *C. guiryi* are very similar to that of *Rhodymenia*; however, *Cordylecladia irregularis* differed on the basis of its terete and narrowly forked fronds, and the formation of reproductive structures in apical, swollen, spindle-like structures. Posterior analysis of 18s sequences from *C. erecta* indicated the close phylogenetic relationship between *Cordylecladia* and *Rhodymenia* (Millar *et al*., 1996; Saunders *et al*., 1999).

Børgesen (1920) proposed transfer of *Cordylecladia irregularis* to a new genus, *Coelothrix*. In addition to the above characterization, *Coelothrix* possesses a small hollow medullary cavity without septa, containing a few longitudinal filaments bearing inwardly-directed gland cells. The cavity is filled with a watery mucilage and tetrasporangia were reported to be tetrahedrally divided (Taylor, 1960). Børgesen (1920) felt that the new genus was more closely related to *Chylocladia* than *Cordylecladia* due to its hollow thallus construction and the possession of glands. Despite these similarities *Coelothrix irregularis* (Harv.) Børgesen was originally placed in the Rhodymeniaceae. Currently *Coelothrix* includes two species, *C. irregularis* and *C. indica* Børgesen (Børgesen, 1944; Guiry and Guiry, 2008). *Coelothrix irregularis* is widespread in the Caribbean (Taylor 1960; Littler and Littler, 2000), the Indian and Pacific Oceans (Silva *et* al., 1996; Guiry and Guiry, 2008) and Portugal (Ardré, 1970), while *C. indica* is only known from Mauritius (Børgesen, 1944, 1950).

Coelothrix irregularis was originally placed within the Rhodymeniaceae (Collins and Hervey, 1917; Britton, 1918; Børgesen, 1920; Britton and Millspaugh, 1920). Kylin (1931) subsequently placed the genus in the Lomentariaceae (prior to the establishment of the Champiaceae); however, he later assigned the genus to the Rhodymeniaceae, as member of the *Chrysymenia* group (Kylin, 1956). Most recent workers followed Kylin's (1931) treatment (e.g. Chapman, 1963; Abbott, 1999; Huisman, 2000; Wynne, 2005a, Schneider and Wynne, 2007; Dawes and Mathieson, 2008) although Taylor (1960) and Ginsburg-Ardré and Palminha (1964) treated the genus as member of the Champiaceae. More recently Guiry and Irvine (1981) and Saunders *et al*. (1999) recognized that placement of *Coelothrix* in the Champiaceae would result in a more natural classification. Le Gall *et al*. (2008) formally transferred *Coelothrix* to the Champiaceae on the bases of morphological characters reported in the literature and molecular sequence data from the large subunit ribosomal gene (28s). The present provides a morphological characterization as well as molecular analyses of the small-subunit ribosomal DNA (18s) and rubisco large rubunit (*rbc*L) sequence data for *Coelothrix irregularis*.

Material and Methods

Specimen collection, DNA extraction, amplification, and sequencing

Specimens were collected by snorkeling and preserved in 10% Formalin/seawater or desiccated in silica gel (Chase and Hills, 1991). Total genomic DNA was extracted, amplified, sequenced and phylogenetic analysis from algal specimens (Table 4 and 5) were performed as detailed in Chapter 3 (Materials and Methods). Authority designations are according to Brummitt and Powell (1992).

The optimal model determined by Modeltest for 18s analysis was the TVM + I + G evolutionary model (Transversion Model + Proportion of Invariable Sites + Gamma distribution) (Posada and Crandall, 2001). The assumed nucleotide frequencies were: A = 0.2485, C = 0.2079, G = 0.2773, T = 0.2663. The assumed substitution rate matrix was: A-C = 1.0275, A-G = 3.5656, A-T= 1.3854, C-G= 0.6801, C-T = 3.5656, G-T= 1.0000. The proportion of sites assumed to be invariable = 0.5745; rates for variable sites were assumed to follow gamma distribution with shape parameter = 0.6895.

Modeltest results indicated that *rbc*L data followed the General Time Reversible + Invariable sites + Gamma Distribution model (GTR + I + G) (Lanave *et al*. 1984; Rodríguez *et al*. 1990). The assumed nucleotide frequencies were: A= 0.3037, C= 0.1423, G= 0.2138, T= 0.3403. The assumed substitution rate matrix was: A-C substitutions = 1.8032, A-G= 7.1902, A-T= 6.8477, C-G= 1.9090, C-T= 17.9572, G-T=1.0000; the proportion of sites assumed to be invariable= 0.5377; rates for variable sites were assumed to follow gamma distribution with shape parameter= 1.4248. The robustness of 18s and *rbc*L data was determined by bootstrapping the data set 2,000 times in MP and NJ analysis and 100 times for ML (Felsenstein, 1985).

Bayesian analysis was performed with Mr.Bayes using HKY + G model (Hasegawa, Kishino, and Yano + Gamma Distribution model) (Hasegawa *et al*., 1985) for 18s analysis and GTR + G (General Time Reversible + Gamma Distribution) (Lanave *et al*. 1984, Rodríguez *et al*., 1990) for *rbc*L analysis. Bayesian analysis for 18s was conducted by running 1,000,000 generations. Trees were sampled every 100 generations with log-likelihood scores stabilized at approximately 4,500 generations. The first 5,000 trees of a possible 10,000 trees were discarded as burn-in. For *rbc*L analysis 1,500,000 generations were run, log-likelihood scores stabilized at approximately 4,800 generations and the first 5,000 trees of 10,000 were discarded as burn-in.

The 18s and *rbc*L sequences from newly sequenced specimens were deposited in GenBank (Table 4 and 5).

Table 4 Species used in 18s gene sequence analysis.

Species	Source	Accession Number	Reference
Botryocladia ebriosa A. Millar	GenBank	AF085255	5
Botryocladia leptopoda (J.Agardh) Kylin	GenBank	DQ343160	6
Botryocladia occidentalis (Børgesen) Kylin (CLT-172)	Isabela, PR	EU086462	This study
Botryocladia sonderi P.C. Silva	GenBank	AF085256	5
Botryocladia wynnei D.L. Ballant. (CLT-176)	Lab culture	EF690267	This study
Botyrocladia. wynnei D.L. Ballant. (CLT-218)	La Parguera, PR	EU670589	This study
Cephalocystis furcellata (J.Agardh) A.Millar, G.W. Saunders, I.M.Strachan *et* Kraft	GenBank	U23953	2
Cerphalocystis leucobotrys A.Millar, G.W. Saunders, I.M.Strachan *et* Kraft	GenBank	U23950	2
Ceratodictyon intricatum[1] (C. Agardh) R. E. Norris	GenBank	EF033594	7
Ceratodictyon spongiosum Zanardini	GenBank	AF117127	5
Ceratodictyon variabile[2] (J. Agardh) R. E. Norris	GenBank	AF085270	5
Champia affinis (Hook. *et*. Harv.) Harv.	GenBank	U23951	2
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF192576	8
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613311	8
Champia cfr. *parvula* (C. Agardh) Harv. (CLT-173)	La Parguera, PR	EF190546	8
Champia cfr. *parvula* (C. Agardh) Harv. (CLT-198)	Culebra, PR	EF613310	8
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF192577	8
Champia salicornioides Harv. (DLB-6873)	Guanica, PR	EF192579	8
Champia vieillardii Kütz. (CLT-165)	La Parguera, PR	EF192580	8
Champia vieillardii Kütz. (CLT-221)	La Parguera, PR	FJ173067	This study
Chylocladia schneideri D.L. Ballant. (CLT-127)	La Parguera, PR	EF192578	8
Chylocladia verticillata (Lightf.) Bliding	GenBank	AF085263	5
Coelarthrum cliftonii (Harv.) Kylin (CLT-197)	La Parguera, PR	EU086465	This study
Coelarthrum opuntia (Endl.) Børgesen	GenBank	AF085258	5
Coelothrix irregularis (Harv.) Børgesen (CLT-171)	La Parguera, PR	EU086456	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-202)	La Parguera, PR	EU086457	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-203)	La Parguera, PR	EU086458	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-215)	La Parguera, PR	FJ173068	This study
Cordylecladia erecta (Greville) J. Agardh	GenBank	U23952	2
Chrysymenia agardhii Harv. (CLT-142)	La Parguera, PR	EF690262	This study
Chrysymenia nodulosa J.N.Norris *et* D.L.Ballant. (CLT-181)	La Parguera, PR	EF690291	This study
Chrysymenia ornata (J.Agardh) Kylin	GenBank	AF085257	5

Dictyothamnion saltatum A. Millar	GenBank	AF085264	5
Drouetia coalescens (Farl.) De Toni	GenBank	DQ343653	6
Epymenia wilsonis Sonder	GenBank	U33128	4
Erythrocolon podagricum (Harv.) J. Agardh	GenBank	U23953	2
Gastroclonium ovatum (Huds.) Papenfuss	GenBank	AF085265	5
Gloiosaccion brownii Harv.	GenBank	AF085259	5
Halichrysis concrescens (J. Agardh) De Toni	GenBank	DQ343654	6
Halychrisis micans (Hauptfl.) P.Huvé *et* H.Huvé	GenBank	DQ343655	6
Halymenia plana Zanardini	GenBank	U33313	4
Irvinea ardreana (J. Brodie *et* Guiry) Guiry	GenBank	AF085254	5
Lomentaria australis (Kütz.) Levring	GenBank	U33134	4
Lomentaria baileyana (Harv.) Farl.	GenBank	L26194	1
Rhodymenia leptophylla J. Agardh	GenBank	U09621	3
Rhodymenia stenoglossa J. Agardh	GenBank	AF085262	5
Sparlingia pertusa (Postels *et* Ruprecht) G.W. Saunders, I.M. Strachan *et* Kraft	GenBank	AF085261	5
Sebdenia flabellata (J. Agardh) P.G.Parkinson	GenBank	U33128	4

[1] Reported as *Gelidiopsis intricata* in Le Gall and Saunders, 2007.
[2] Reported as *Gelidiopsis variabilis* in Saunders *et al*., 1999.
1) Ragan *et al*., 1994; 2) Millar *et al*.,1996; 3) Saunders and Kraft, 1994; 4) Saunders and Kraft,1996; 5) Saunders *et al*., 1999 ; 6) Saunders *et al*., 2006; 7) Le Gall and Saunders, 2007; 8) Ballantine and Lozada-Troche, 2008.

Table 5 Species used in *rbc*L gene sequence analysis.

Species	Source	Accession Number	Reference
Botryocladia botryoides (Wulfen) J. Feldmann	GenBank	AY444169	6
Botryocladia canariensis Afonso-Carillo *et* Sobrino	GenBank	AY444172	7
Botryocladia caraibica Gavio *et* Fredericq	GenBank	AY168665	3
Botryocladia caraibica Gavio *et* Fredericq	GenBank	AY168666	3
Botryocladia ebriosa A. Millar	GenBank	AY444171	6
Botryocladia madagascariensis G. Feldmann	GenBank	AY444168	7
Botryocladia monoica Schnetter	GenBank	AY168658	3
Botryocladia occidentalis (Børgesen) Kylin	GenBank	AY168660	3
Botryocladia occidentalis (Børgesen) Kylin (CLT-172)	Isabela, PR	EU086463	This study
Botryocladia papenfussiana Ganesan *et* Lemus	GenBank	AY444173	7
Botryocladia pyriformis (Børgesen) Kylin	GenBank	AY168664	3
Botryocladia shanksii E.Y. Dawson	GenBank	AY168662	3
Botryocladia skottsbergii (Børgesen) Levring	GenBank	AY444175	7
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott	GenBank	AY444174	6
Botrycladia sp.	GenBank	AY444170	7
Botryocladia uvarioides E.Y. Dawson	GenBank	AY168663	3
Ceratodyction spongiosum Zanardini	GenBank	U21639	9
Ceratodictyon sp.[1]	GenBank	AY294357	5
Champia compressa Harv.	GenBank	AY294358	5
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF613316	8
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613317	8
Champia cfr. *parvula* (C. Agardh) Harv. (CLT-173)	La Parguera, PR	EU086464	8
Champia cfr. *parvula* (C. Agardh) Harv. (CLT-198)	Culebra, PR	EF613312	8
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF613314	8
Champia salicornioides Harv. (DLB-6873)	Guanica, PR	EF613315	8
Chylocladia schneideri D.L.Ballant. (CLT-127)	La Parguera, PR	EF613313	8
Coelarthrum cliftonii (Harv.) Kylin (CLT-235)	La Parguera, PR	EU715136	This study
Coelothrix irregularis (Harv.) Kylin (CLT-171)	La Parguera, PR	EU086459	This study
Coelothrix irregularis (Harv.) Kylin (CLT-215)	La Parguera, PR	EU670598	This study
Cordylecladia erecta (Greville) J. Agardh	GenBank	AY444178	6
Chrysymenia agardhii Harv. (CLT-142)	La Parguera, PR	EF690262	This study
Chrysymenia procumbens Weber Bosse	GenBank	AY294381	5

Epymenia capensis (J. Agardh) Papenfuss	GenBank	AF385646	4
Epymenia obtusa (Greville) Kütz.	GenBank	AF385647	4
Epymenia wilsonis Sonder	GenBank	AF385650	4
Halymenia floresii (Clemente *et* Rubio) C. Agardh	GenBank	AY294398	5
Halichrysis micans (Hauptfl.) P.Huvé *et* H.Huvé	GenBank	AB038603	2
Irvinea ardreana (J. Brodie *et* Guiry) Guiry	GenBank	U21641	9
Irvinea boergesenii (Feldmann) R.J. Wilkes, L.M. McIvor *et* Guiry	GenBank	AY444177	6
Lomentaria catenata Harv.	GenBank	AY444176	7
Lomentaria hakodatensis Yendo	GenBank	U21642	4
Lomentaria hakodatensis Yendo	GenBank	AY294380	5
Maripelta rotata (E.Y.Dawson) E.Y. Dawson	GenBank	AY444179	6
Neogastroclonium subarticulatum[2] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	U04180	1
Neogastroclonium subarticulatum[3] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	AY294398	5
Rhodymenia corallina (Bory de Saint-Vincent) Greville	GenBank	AY168657	3
Rhodymenia divaricata E.Y. Dawson	La Parguera, PR	EU670597	This study
Rhodymenia intricata (Okamura) Okamura	GenBank	DQ787591	9
Rhodymenia pseudopalmata (J.V. Lamouroux) P.C. Silva	GenBank	AY168656	3
Rhodymenia skottsbergii E.Y. Dawson	GenBank	AY294354	5
Rhodymenia sp.	GenBank	AF385651	4

[1] Reported as *Gelidiopsis* sp. in Gavio *et al*. (2005).
[2]Reported as *Gastroclonium coulteri* in Freshwater *et al*. (1994), now considered a synonym of *G. subarticulatum*.
[3]Reported as *Gastroclonium subarticulatum* by Gavio *et al*. (2005).
1) Freshwater *et al*., 1994; 2) Wang *et al*., 2000; 3) Gavio and Fredericq, 2003; 4) Hommensand and Fredericq, 2003;
5) Gavio *et al*., 2005; 6) Wilkes *et al*., 2005; 7) Wilkes *et al*., 2006; 8) Ballantine and Lozada-Troche, 2008;
9) unpublished GenBank sequence.

Results

Coelothrix irregularis (Harv.) Børgesen

Plants form firm turf-like cushions (Fig. 5) which are up to 3 cm in height and 7.5-8 cm in breadth. The iridescent erect thalli are terete, measuring 460-570 µm in diameter and 2-3 cm height and are irregularly branched. Branches are frequently anastomosed. Thalli diameter is normally 460-570 µm in diameter increasing to 700 – 800 µm when tetrasporangia are present. Axes distally possess a cluster of 25-30 irregularly arranged apical cells, which measure 5-7.5 µm in diameter (Fig. 6). These give rise to longitudinal filaments that measure 2.5-5 µm in diameter and run along the inner surface of medullary cells (Figs. 7-9). The filaments bear inwardly-directed pyriform gland cells (12.5-20 µm in width) (Figs. 7-8).

The thallus medulla is composed of 5-6 layers of large radially elongate cells (25-50 x 20-30 µm) covered by a single layer of small cortical cells (12.5-22.5 x 7.5-12.5 µm) (Fig. 9). Axes lack septa (Fig. 10) and are filled with a watery mucilage. Tetrasporangia develop in swollen branches measuring 1.5-3.0 mm in length (Fig. 11), develop inwardly (Fig. 12) and measure 57.5-67.5 µm long x 25-37.5 µm width. Tetrasporangial origin appears to be by division of cortical cells (Fig. 13). The tetrasporangia have terminal disposition (Fig. 14), are ovate in shape and are divided in a decussate cruciate pattern (Fig. 15); however, some tetrasporangia appeared to be cruciatelly divided (Figs. 15-16). Cystocarps and spermatangia were not observed in the specimens examined. A comparison between *Coelothrix* and the genera presently included in the Champiaceae is given in Table 6. Collection information for the herbarium specimen examined is: MSM-17777, Turrumote Reef, La Parguera, 0.3-0.6 m, Coll. ManuelDíaz.-Piferrer, 1.viii.1961.

Fig. 5 *Coelothrix irregularis* (CLT-215). Habit. Scale bar = 5.0 mm. (Photo taken by Héctor Ruíz).

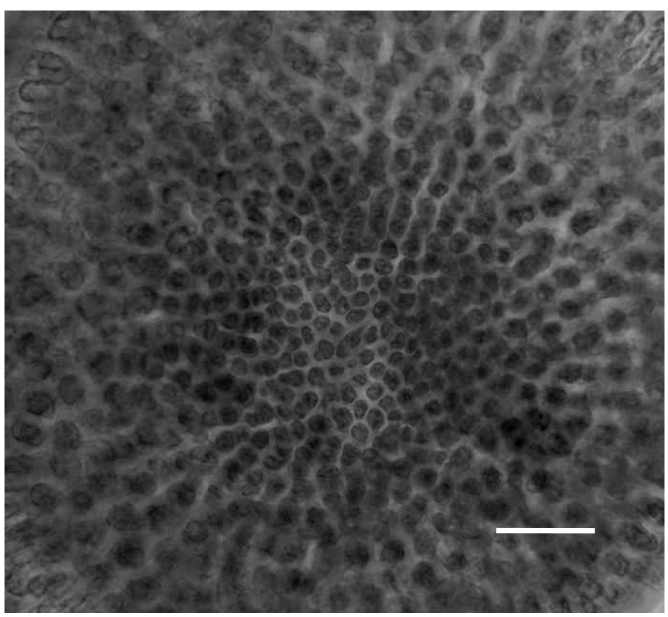

Fig. 6 *Coelothrix irregularis* (CLT- 287). Irregular cluster of apical cells. Scale bar = 5 µm.

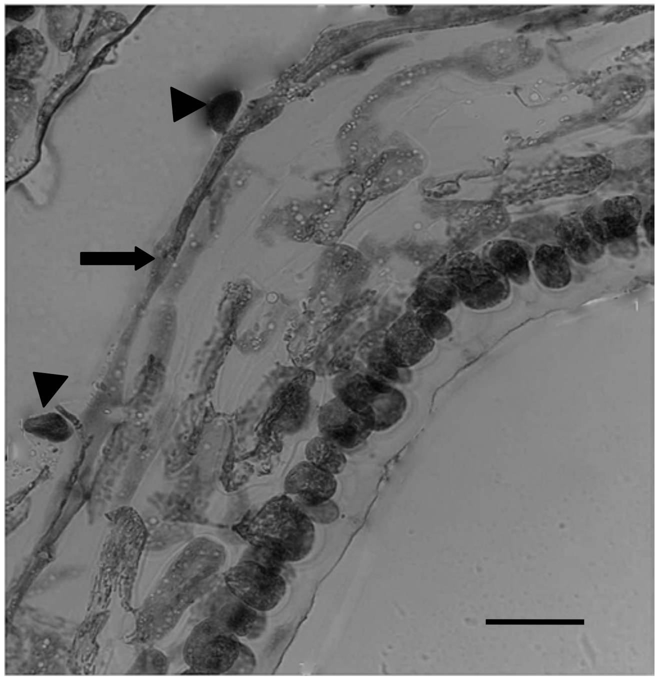

Fig. 7 *Coelothrix irregularis* (CLT-287). Longitudinal section showing a single medullary filament (arrow) to the inside of the medullary layers, bearing two gland cells (arrowheads). Scale bar = 500 µm.

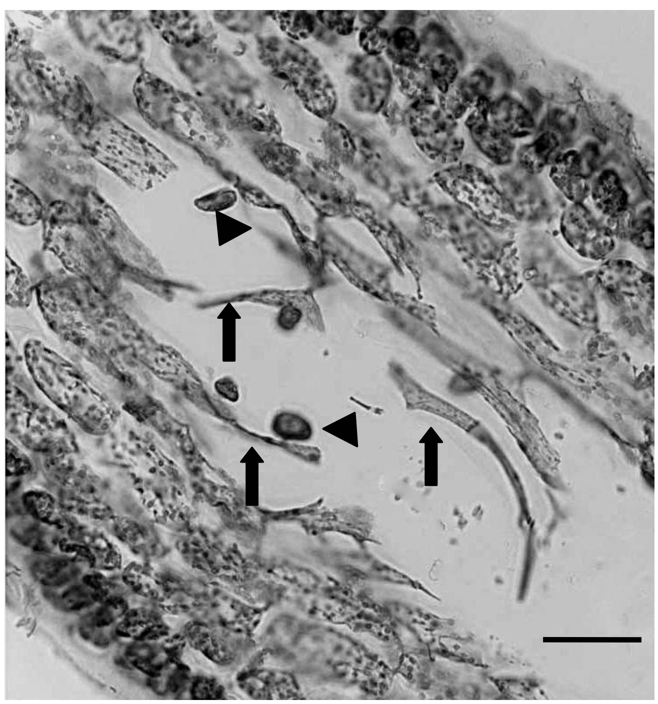

Fig. 8 *Coelothrix irregularis* (CLT-287). Longitudinal section showing portions of longitudinal filaments (arrows) bearing gland cells (arrowheads). Scale bar = 20 µm.

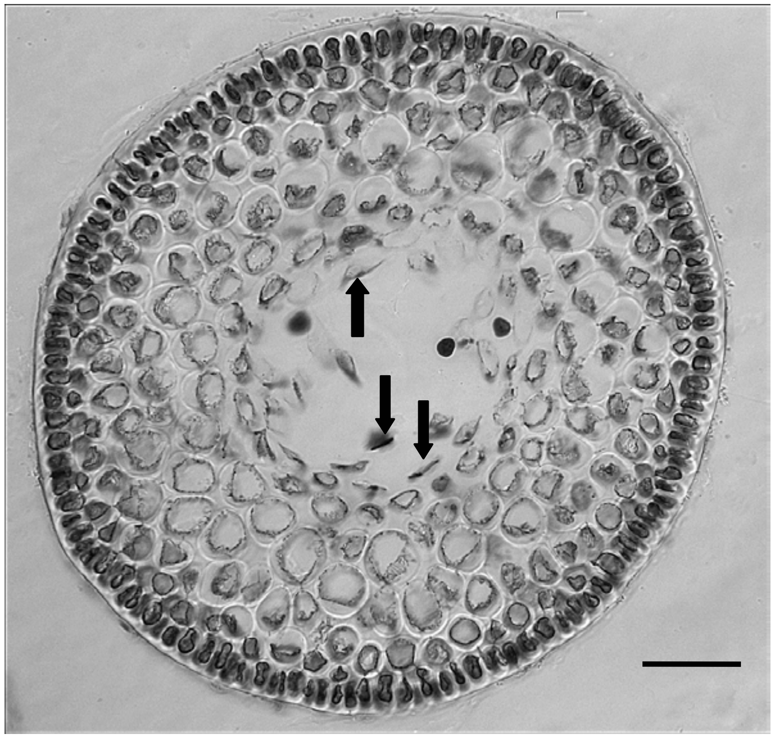

Fig. 9 *Coelothrix irregularis* (CLT-202). Transverse section showing the hollow central region surrounded by approximately 6 layers of medullary cells and an outer layer of radially elongate cortical cells. Fragments of medulary filaments are seen at center (arrows). Scale bar = 500 µm.

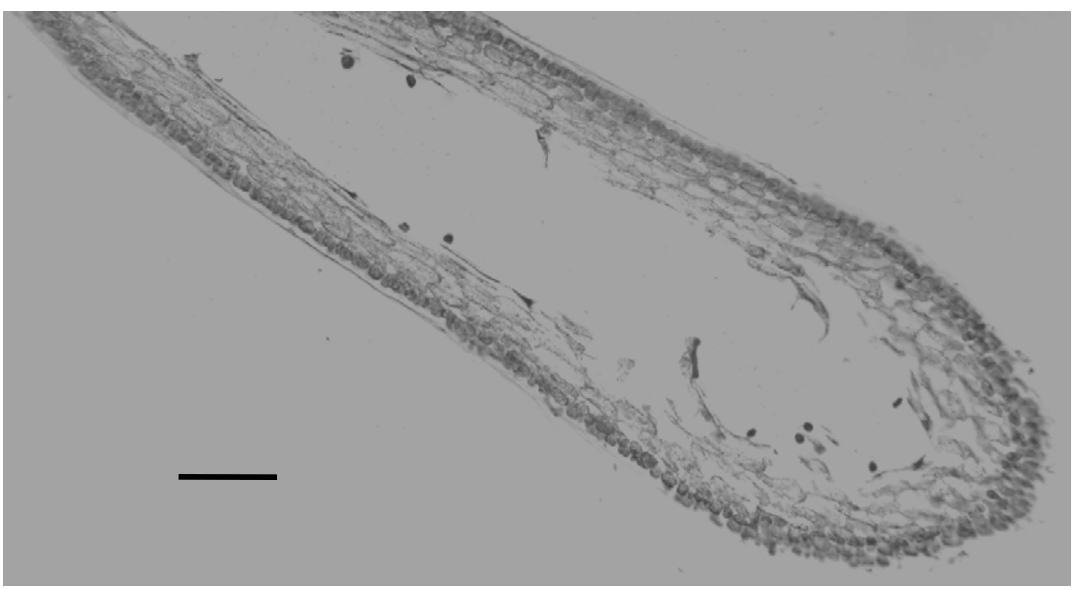

Fig. 10 *Coelothrix irregularis* (CLT-287). Longitudinal section showing absence of septa. Scale bar = 400 µm.

Fig. 11 *Coelothrix irregularis* (CLT-287). Swollen tetrasporangial branch tip. Scale bar = 3 mm. (Photo taken by Héctor Ruíz).

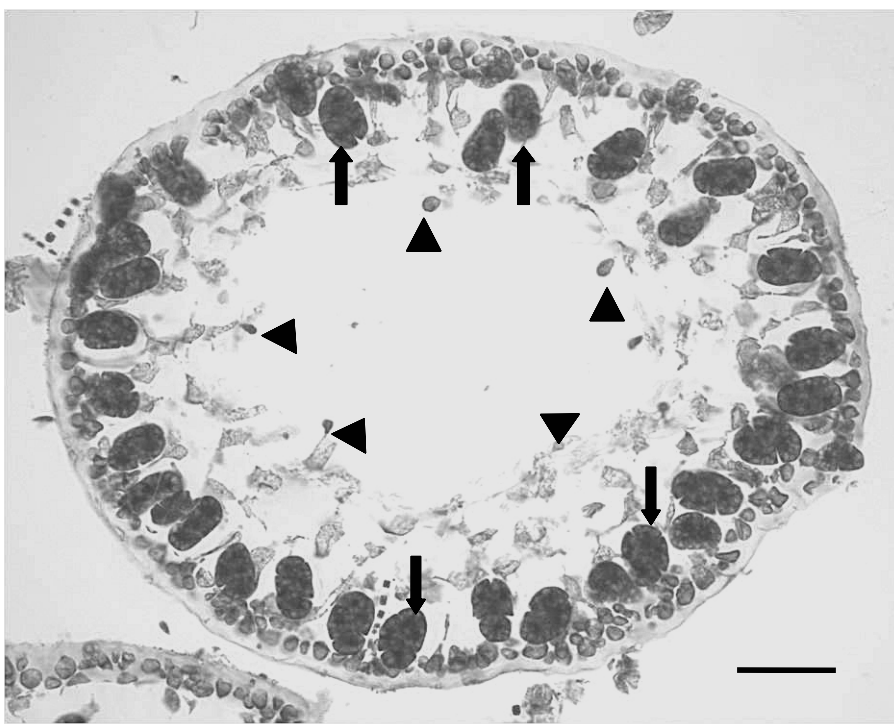

Fig. 12 *Coelothrix irregularis* (CLT-215). Transverse section through tetrasporangial plant. Tetrasporangia, originating from cortical cells are cut off inwardly (arrows). Pyriform gland cells (arrowheads) are directed inwardly in the medulla. Scale bar = 700 µm.

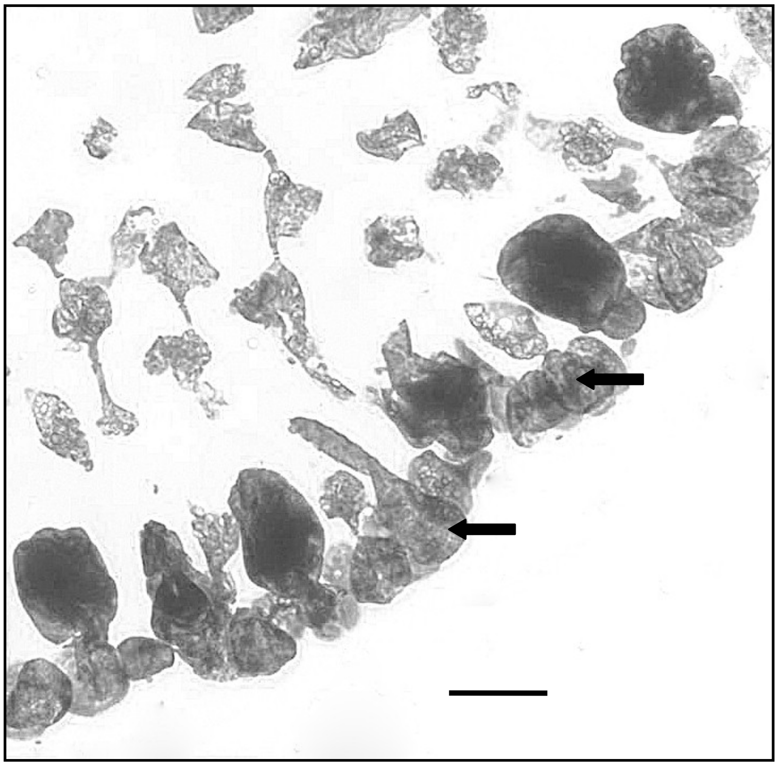

Fig. 13 *Coelothrix irregularis* (CLT-215). Transverse section with developing tetrasporangia (arrows) arising from cortical cells. Scale bar = 50 µm.

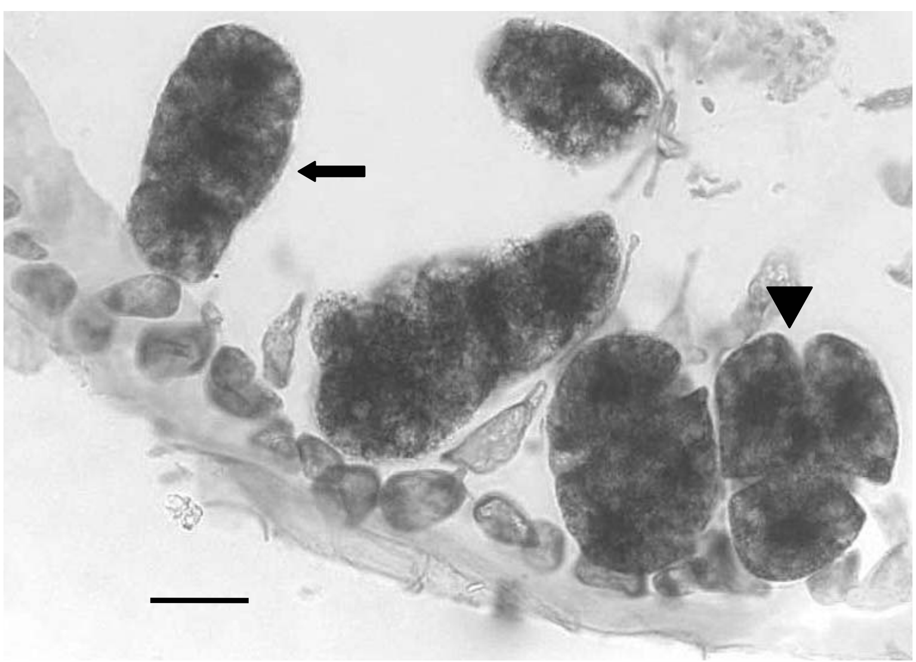

Fig. 14 *Coelothrix irregularis* (CLT-215). Transverse section with developing tetrasporangia (arrow) attached to cortical cells. A cruciate tetrasporangium is denoted by an arrowhead. Scale bar = 50 µm.

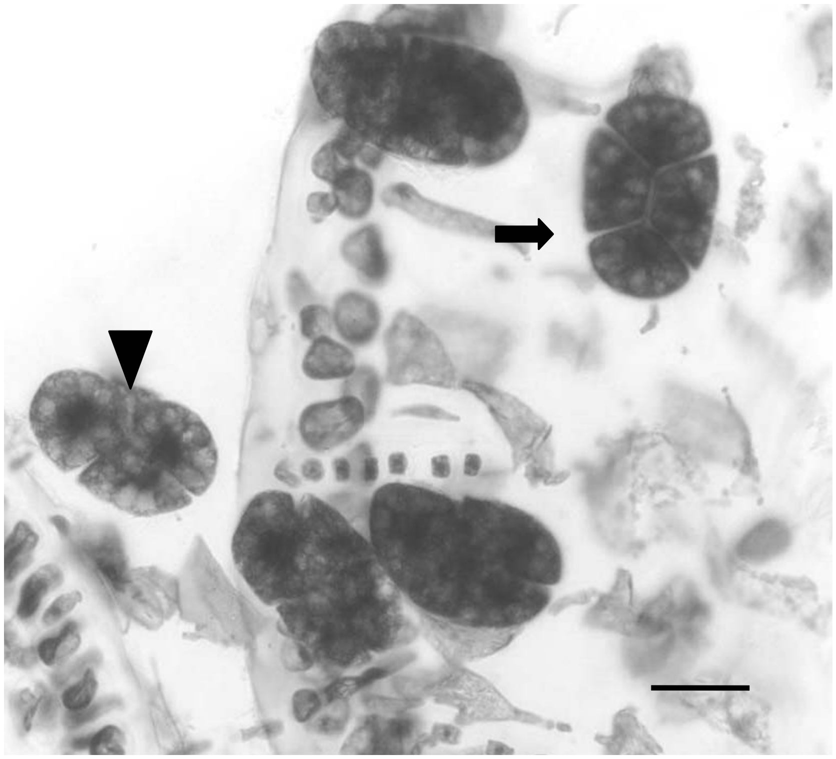

Fig. 15 *Coelothrix irregularis* (CLT-215). Transverse section showing various tetrasporangia appearing to be divided in a deccusate cruciate pattern (arrow) and a cruciate pattern (arrowhead). Scale bar = 50 µm.

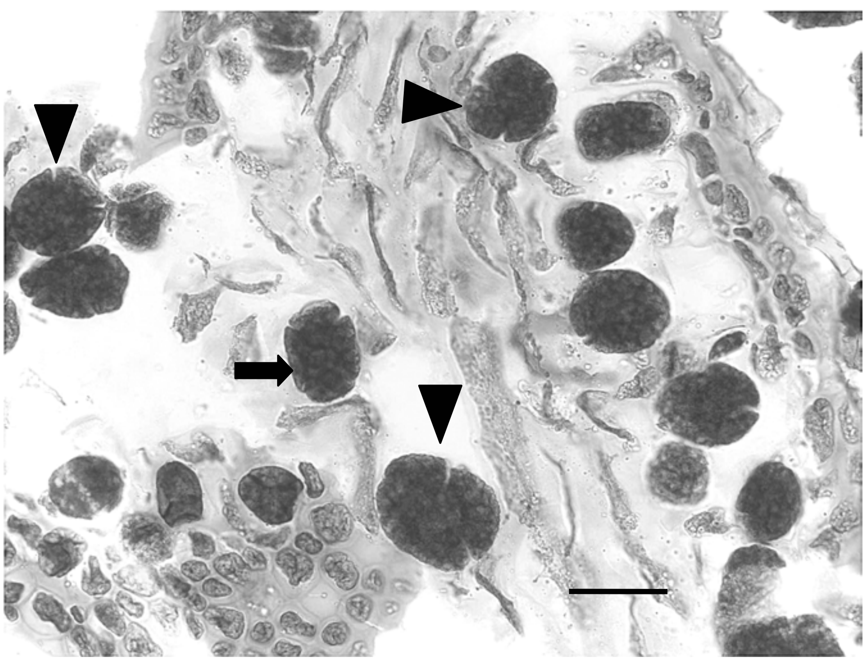

Fig. 16 *Coelothrix irregularis* (MSM-17777). Tetrasporangia from a herbarium specimen showing decussate cruciate division (arrow) and some developmental stages that resemble cruciate division (arrowheads). Scale bar = 50 µm.

Table 6 Comparison between *Coelothrix* and other genera included in the Champiaceae.

Characteristic	*Coelothrix*	*Champia*	*Champiocolax*	*Chylocladia*	*Gastroclonium*	*Dictyothamnion*
Thallus shape	Terete	Terete or compressed	Globose to subfusiform	Terete	Terete	Terete
Tetrasporangial division	Decussate-cruciate Tetrahedral[1]	Tetrahedral	Tetrahedral	Tetrahedral	Tetrahedral	Tetrahedral
Tetrasporangial origin	Derived by division of cortical cells	Derived by division or transformation of cortical cells	Derived by transformation of cortical cells	Derived by transformation of cortical cells	Derived from cortical cells but process not specified	Derived from cortical cells but process not specified
Tetrasporangial (diameter)	25-37.5 µm	50-100 µm	14-25 µm	35-200 µm	65-85 µm	40 µm
Cortex	1 layer	2-3 layers	1-2 layers	1 layer	1 layer	Rosettes of small cells
Segmentation	Absent	Single layered	Single layered	Single layered	Single layered	Multicellular
Medullary filaments	Along the inner surface of medullary cells	Peripheral and in the central region of the thallus	Along the interior of the cortex	Along the inner surface of medullary cells and in center cavity	Along small cells covering the cortex	Along the thallus internal cavity
Cystocarp shape, ostiole	Spherical, Not specified	Urn-shape, ostiolate	Ovate-subglobose, non-ostiolate	Spherical, non-ostiolate	Globose, non-ostiolate	Spherical, ostiolate
Cystocarp diameter	Up to 600 µm	Up to 900 µm	250 µm	Up to 500 µm	Up to 600 µm	1000 µm
Gametophytes	Dioecious	Dioecious	Monoecious	Dioecious	Dioecious	Dioecious

Table 6 cont.

Characteristic	*Coelothrix*	*Champia*	*Champiocolax*	*Chylocladia*	*Gastroclonium*	*Dictyothamnion*
Spermatangial origin	Cortical cells	Cortical cells	Small cortical cells	Small cortical cells or cells on the outer face of cortical cells	Filaments derived from cortical cells	Small cortical cells
References	This study; Collins (1901) Børgesen (1944); Taylor (1960); Dawes and Mathieson (2008)	Taylor (1960); Reedman and Womersley (1976); Irvine and Guiry (1983); Ballantine-Lozada Troche (2008)	Bula-Meyer (1985)	Irvine and Guiry (1983); Ballantine (2004); Guiry and Guiry (2008); Alongi *et al.* (2008)	Hawkes and Scagel (1986); Ballantine (2004); Guiry and Guiry (2008)	Millar (1990)

[1]Tetrahedral division has been reported by Taylor (1960).

Molecular analyses

DNA sequences of 18s and *rbc*L genes from species representing the families Rhodymeniaceae, Champiaceae, and Lomentariaceae within the order Rhodymeniales were analyzed to corroborate the taxonomic affiliation of *Coelothrix irregularis*. Forty-eight 18s sequences (Table 4) were used to construct a phylogenetic tree (Fig. 17). Eleven new small ribosomal subunit gene sequences were generated from various genera including *Botryocladia* spp., *Coelarthrum cliftonii* (Harv.) Kylin, *Coelothrix irregularis*, *Chrysymenia* spp., and *Champia vieillardii* Kütz. Length of new 18s sequences varied from 1703 to 1770 bp. Small ribosomal subunit sequence divergence between *Coelothrix irregularis* and Champiaceae members varied from 1.5 to 4.5%.

Fifty-one *rbc*L sequences were tested to verify the results obtained from the 18s analysis (Table 5). Approximately 1,300 bp from six new sequences representing *Coelothrix irregularis*, *Botryocladia occidentails* (Børgesen) Kylin, *Coelarthrum cliftonii* (Harv.) Kylin, *Chrysymenia agardhii* (Melvill) J.Agardh, and *Rhodymenia divaricata* E.Y.Dawson were also included in the *rbc*L analysis. Intraspecific *rbc*L sequence divergence between *Coelothrix irregularis* and Champiaceae members was 9.8-11%. *Coelothrix irregularis* placement in the Champiaceae was confirmed by both 18s and *rbc*L sequence phylograms (Figs. 17, 18). *Coelothrix irregularis* represents a sister taxa of *Chylocladia spp.*, *Gastroclonium* and *Neogastroclonium* with moderate to highly supported bootstrap and posterior probability values. Also, generic assignment of the recently described *Chylocladia schneideri* D.L.Ballant. (2004) is highly supported with more than 85% bootstrap and posterior probability values in all optimality criteria tested, indicating that is a sister taxon of *Chylocladia verticillata* (Lightfoot) Bliding and *Gastroclonium ovatum* (Hudson) Papenfuss (Fig. 17).

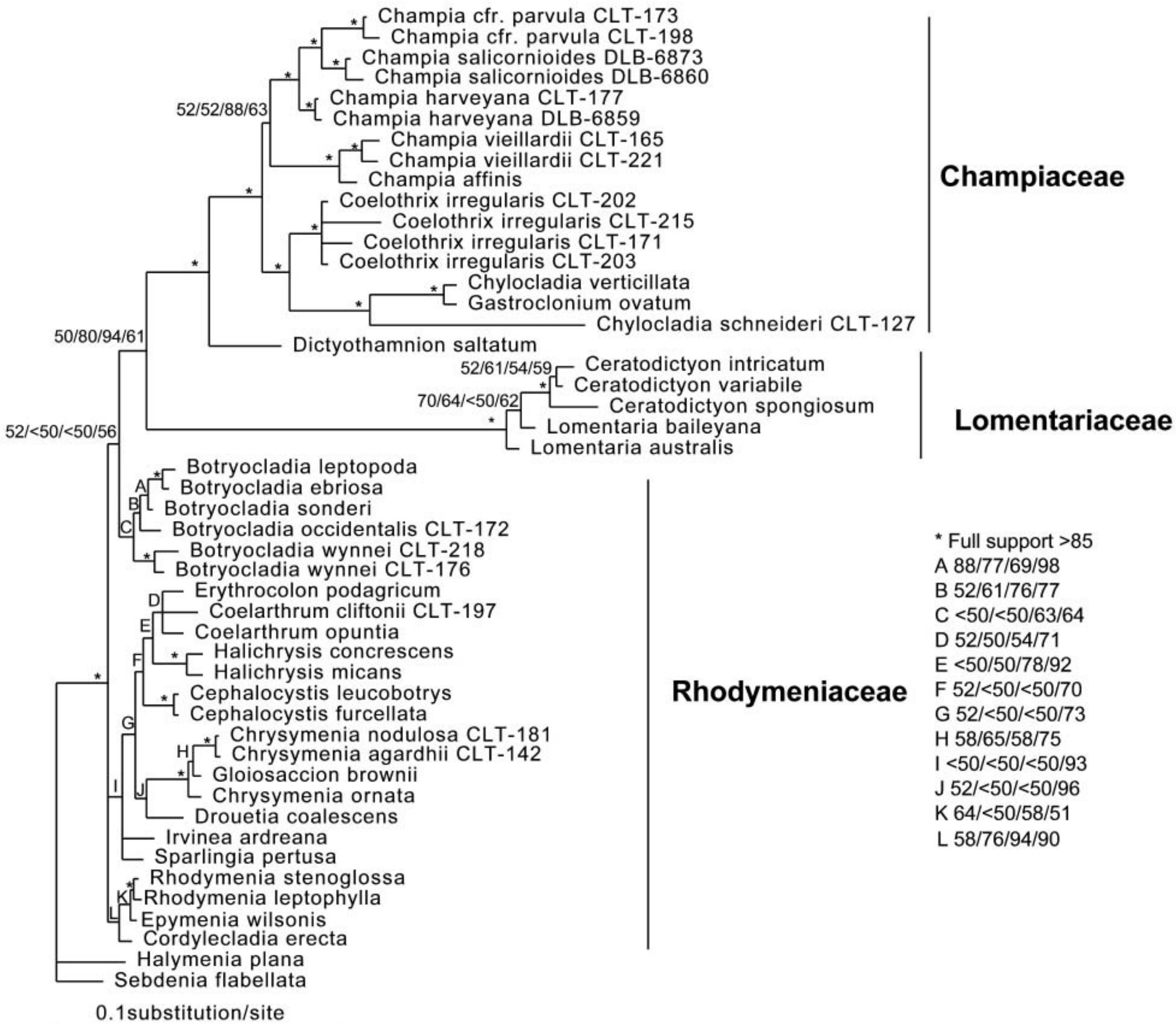

Fig. 17 Small ribosomal subunit (18s) sequence phylogram using Bayesian Analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Likelihood, 100 replicates; Maximum Parsimony, 2000 replicates; Neighbor Joining, 2000 replicates; Bayesian posterior probabilities, 1,000,000 generations.

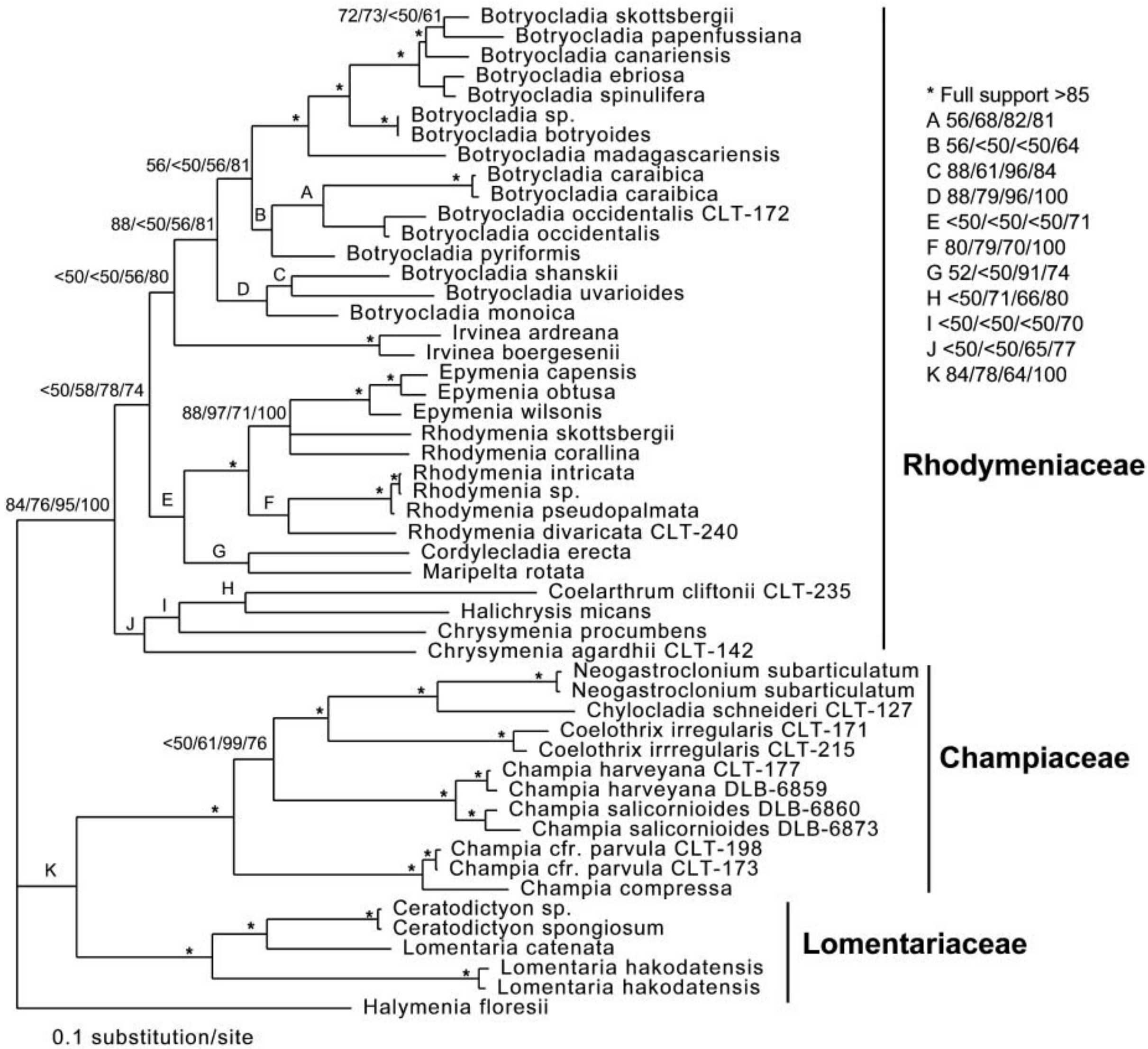

Fig. 18 Rubisco large subunit (*rbc*L) sequence phylogram inferred from Bayesian analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Likelihood, 100 replicates; Maximum Parsimony, 2000 replicates; Neighbor-Joining, 2000 replicates; Bayesian posterior probabilities, 1,500,000 generations.

Discussion

The Champiaceae comprise plants that are mostly or partly hollow with longitudinal filaments bordering the thallus cavity. Carpogonial branches are composed of 4 cells and prior to the inclusion of *Coelothrix*, the axes of genera comprising the family have been septate, with septa being a single cell thick. Carposporangia develop only from the surface gonimoblast layers, and tetrasporangia are cut off inwardly from cortical cells and lie in an intercalary position (Reedman and Womersley, 1976; Irvine and Guiry, 1983; Womersley, 1996). This tetrasporangial initiation, however, is at odds with that previously reported for the Champiaceae in which tetrasporangial are assumed to arise as transformed cortical cells (Reedman and Womersley, 1976). Nevertheless, Ballantine and Lozada-Troche (2008) found that in *Champia harveyana* D.L.Ballant. *et* Lozada-Troche, the tetrasporangia appear to result from a division of the cortical cell with the larger division product becoming the tetrasporangium. *Coelothrix irregularis* tetrasporangial development also is the result of division of the cortical cell to produce the tetrasporangium (see Fig. 13).

Molecular analyses using 18s and *rbc*L genes support the placement of *Coelothrix irregularis* as a member of the Champiaceae. This placement is highly supported by bootstrap and posterior probability values for both genes analyzed (Figs. 17 and 18). The genera placed by Kylin in the Champiaceae have gland cells borne on the longitudinal filaments lining the hollow cavities (Guiry and Irvine, 1981). This is also the case for *Coelothrix*, which shares principal vegetative characters with other Champiaceae members including terete hollow thalli with longitudinal filaments bearing gland cells. The Champiaceae is also characterized by the presence of regular septation within the thallus, and thus *Coelothrix* becomes the only member of the family that lacks septa. *Coelothrix* apical construction is similar to that observed in the genus

Champia, however the arrangement of apical cells in *Coelothrix* is irregular as opposed to symmetrical in *Champia.* Another difference between *Coelothrix* and the typical Champiaceae is the medullary and cortical construction. The wall in *Champia* and *Chylocladia* is a single cortical layer with medullary filaments to the inside. In contrast *Coelothrix* posess a multicellular medulla and therefore inclusion of *Coelothrix* in the Champiaceae thus necessitates the broadening of the familial characterization. A similar case is seen in the Lomentariaceae, which also includes genera with a single cortical layered wall (i.e. *Lomentaria*) and those with a more substantial medullary development (i.e. *Gelidiopsis*).

The cystocarp in the members of the Champiaceae is usually an urn-shaped or spherical with or without a carpostome. Although a single cystocarp of *C. irregularis* has been reported (Collins, 1901, as *C. erecta*) on one occasion, no detailed account was provided other than that it was spherical in shape and developed externally. According to Ginsberg-Ardré and Palmahina (1964) spermatia of *C. irregularis* develop from spermatangial mother cells derived from cortical cells, similarly to other members of the Champiaceae and Lomentariaceae (Reedman and Womersley, 1976; Lee, 1978; Schneider and Searles, 1991).

Coelothrix tetrasporangial division in Puerto Rican specimens is principally decussate cruciate, although tetrasporangial division patterns appearing to be tetrahedral and cruciate have been seen in sections as well. The appearance of these different division patterns may be a result of maturation stage, and viewing or cutting angle of sections. Børgesen (1950) described the tetrasporangial division pattern as being mostly cruciate and irregular on his augmented description of *Coelothrix indica* (Fig. 21 b-e, p. 42). Lee (1978) in his account of *Chrysymenia wrigthtii* illustrated the development of cruciate tetrasporangial division in the species and illustrated developmental stages that resemble tetrahedral division (Fig. 40C, p. 100).

Tetrasporangial division misinterpretation has also been documented in other Rhodymeniales including *Gloiocladia furcata* (C. Agardh) J. Agardh and *Leptofauchea brasiliensis* A.B. Joly (Irvine and Guiry, 1980; Schneider and Searles, 1991) in which initially a tetrahedral division pattern was reported but subsequent studies demonstrated cruciately divided tetrasporangia. A cruciate division pattern is considered to be the ancestral tetrasporangial condition in Rhodymeniales (Saunders *et al*. 1999). With the exception of *Coelothrix*, all Champiaceae members possess tetrahedrally divided tetrasporangia. Thus the tetrasporangial division pattern in *Coelothrix* makes the genus unique among genera within the family. Guiry (1990) observed that tetrahedral division is relatively rare in the Rhodophyta and that it has probably evolved only four times in the Rhodymeniales. It has also been speculated that terminal position of tetrasporangia is an ancestral condition for the order (Saunders *et al*., 1999; Le Gall *et al*., 2008). Furthermore, Le Gall *et al*. (2008) speculated that the rhodymenialean ancestor possessed cruciately divided tetrasporangia. *Coelothrix* would appear to possess the tetrasporangial division considered to be the ancestral condition (e.g. cruciate vs tetrahedral division) for the order. Most *C. irregularis* accounts have reported intercalary tetrasporangial disposition (Taylor, 1960; Littler and Littler, 2000; Dawes and Mathieson, 2008), however, tetrasporangia were observed to be terminal in our sections. Intercalary position of tetrasporangia is considered to be a derived character rather than ancestral (terminal disposition). It would thus appear that *Coelothrix* possesses a unique set of characters which can be considered ancestral in the evolution of the order Rhodymeniales.

Chapter 5: A new *Champia* species from Puerto Rico and the molecular distinction between *Champia vieillardii* and *C. compressa*

Summary – Morphological examination of specimens referable to *Champia parvula* collected in seagrass beds have resulted in the recognition of a new *Champia* species. The new species bears strong resemblance to type specimens of *C. parvula*, mainly differing in branching pattern (opposite vs typically alternate) and origin (between the septa vs nodal region), number of axes arising from holdfasts (4-7 vs 1 or more), and monoecious vs dioecious gametophytes. The taxonomic position of the new species was determined using data from the small ribosomal subunit (18s) and rubisco large subunit (*rbc*L) genes and was highly supported for all optimality criteria tested. The new species clades most closely with C. *vieillardii*, *C. compressa* as well as what is tentatively referred to *Champia parvula* from Puerto Rico. Furthermore, *rbc*L sequence comparison between *C. vieillardii* and *C. compressa* supports their recognition as distinct species.

Introduction

The morphology and reproduction of the genus *Champia* has been extensively studied (Bigelow 1888; Davis 1892, 1896; Nott, 1896; Bliding, 1928; Kylin, 1931; Reedman and Womersley, 1976; Bula-Meyer, 1997; Millar, 1998; Wynne, 1998; Ballantine and Lozada-Troche, 2008). There are approximately 39 species of *Champia* worldwide (Guiry and Guiry, 2008; Ballantine and Lozada-Troche, 2008). Eight *Champia* species are currently recognized from the Atlantic (Wynne, 2005a, Ballantine and Lozada-Troche, 2008) including *C. parvula* (C. Agardh) Harv., *C. salicornioides* Harv., *C. harveyana* Ballantine *et* Lozada-Troche, C. *vieillardii* Kütz., *C. compressa* Harv., *C. feldmanii* Díaz-Piferrer, *C. minuscula* A.B.Joly *et* Ugadim and *C. taironensis* Bula-Meyer. The first four are known from Puerto Rico (Ballantine and Aponte, 2002b; Ballantine and Lozada-Troche, 2008). Although the genus has been widely reported throughout the world, some authors believe that many records need verification (Irvine and Guiry, 1983; Womersley, 1996; Guiry and Guiry, 2008). This assumption also applies to *Champia parvula* (C. Agardh) Harv., the most common species of the genus (Guiry and Guiry, 2008). *Champia parvula* has been recorded from most temperate and tropical coasts of the world (Taylor, 1960; Reedman and Womersley, 1976; Guiry and Guiry, 2008). However, Irvine and Guiry (1983) speculated that this species, with its type locality in Spain, is restricted to the eastern Atlantic and is not as widely distributed as reports indicate. This suggests the possibility that *Champia parvula* reports from the western Atlantic, including the Caribbean, may represent a complex of species rather than a single entity.

Champia parvula was originally described as *Chondria parvula* C. Agardh (1824) and the type locality was Cadiz, Spain. The species is characterized by possessing terete hollow thalli with segments separated by septal region and longitudinal filaments lining the inner cortex which originate from a cluster of apical cells (Bliding, 1928; Irvine and Guiry, 1983). Branches in European plants originate from the septa and possess an alternate pattern (Irvine and Guiry, 1983). The tetrasporangia are tetrahedrally divided and are reported as being intercalary (Irvine and Guiry, 1983). Spermatangia on male plants are derived from the outer faces of cortical cells. Procarps in female gametophytes possess a 4-celled carpogonial branch and a 2-celled auxiliary cell branch. Cystocarps are outwardly conspicuous, possess “tela arachnoidea” and a well-developed ostiole (Irvine and Guiry, 1983).

Branching pattern in specimens referred to *Champia parvula* from the western Atlantic (including the Caribbean) has been reported as variable, however by most accounts, it is alternate (Harvey, 1853; Taylor, 1960; Schneider and Searles, 1991; Littler and Littler, 2000; Littler *et al*., 2008). Nevertheless no information regarding branch origin is discussed in any of these accounts. In the western Atlantic, *Champia parvula* has been reported as growing epiphytically in *Thalassia* beds of Florida, Costa Rica, and Puerto Rico (Taylor, 1960; Ballantine and Humm, 1975; Soto and Ballantine, 1986; Littler and Littler, 2000; Dawes and Mathieson, 2008).

In the genus *Champia*, tetrasporangia are tetrahedrally divided and are reported as being intercalary (Reedman and Womersley, 1976, Irvine and Guiry, 1983). Tetrasporangia in the genus have additionally been reported to be transformed cortical cells (Reedman and Womersley, 1976). Spermatangia on male plants are derived from the outer faces of cortical cells. Procarps in female gametophytes possess a 4-celled carpogonial branch and a 2-celled auxiliary cell branch. Cystocarps are outwardly conspicuous and possess "tela arachnoidea".

Two *Champia* species which have been historically confused are *C. compressa* Harv. and *C. vieillardii* Kütz. Both are superficially similar in morphological characters including a flattened thallus. *Champia compressa* has been reported in the Caribbean by Díaz-Piferrer (1970) including Puerto Rico by Almodovar and Ballantine (1983). Currently there are three flat *Champia* species reported from the Caribbean: *C. compressa*, *C. taironensis* Bula-Meyer and *C. vieillardii* (Ballantine and Aponte, 2002b; Bula-Meyer, 1997). Nevertheless, it is now generally regarded that *C. vieillardii* is the only flattened *Champia* species in Puerto Rico (Ballantine and Aponte, 2002b).

Two sympatrically growing *Champia parvula*-like entities have been recognized in Puerto Rico that differ molecularly. One of these exhibits consistent morphological differences as compared to European accounts of *C. parvula* with respect to branching pattern and origin. It is recognized, as a new species. Furthermore, molecular evidence provided herein supports the differentiation of *C. vieillardii* from *C. compressa*.

Materials and Methods

Specimens were collected by snorkeling on seagrass beds in La Parguera, Puerto Rico at a depth of 1-2 m, and preserved in 10% Formalin/seawater or desiccated in silica gel for molecular studies. Voucher specimens have been deposited in the Herbario Marino Puertorriqueño (MSM). Herbarium abbreviations follow Holmgren *et al.* (1990), and authority designations are according Brummitt and Powell (1992). DNA extraction, PCR amplification, sequencing from algal specimens (Tables 7, 8), and phylogenetic reconstruction were performed using the protocols described in Chapter 3. The phylogenetic reconstruction was performed using the MP, NJ, and ML algorithms as implemented in PAUP* (Swofford, 2002) and Bayesian analysis using Mr.Bayes v.3.1.2 (Huelsenbeck and Ronquist, 2001). The optimal model determined by Modeltest for 18s analysis was the GTR + I + G evolutionary model (General Time Reversal + Invariable Sites + Gamma distribution) (Lanave *et al*., 1984; Rodríguez *et al*., 1990). The assumed nucleotide frequencies were: A = 0.2530, C = 0.2032, G = 0. 2776, T = 0. 2662. The assumed substitution rate matrix was: A-C = 0.9262, A-G = 2.6093, A-T = 1.2905, C-G = 0.64968, C-T = 3.6645, G-T = 1.0000. The proportion of sites assumed to be invariable = 0.5395; rates for variable sites were assumed to follow gamma distribution with shape parameter = 0.6568.

The optimal model for *rbc*L data was also GTR + I + G. The assumed nucleotide frequencies were: A= 0.3093, C= 0.1403, G= 0.2071, T= 0.3433. The assumed substitution rate matrix was: A-C substitutions = 1.3537, A-G= 8.0169, A-T= 6.1049, C-G= 1.7484, C-T= 18.4578 G-T=1.0000; proportion sites assumed to be invariable = 0.5200, and rates for variable sites were assumed to follow gamma distribution with shape parameter = 1.1106. The robustness of 18s and *rbc*L data was determined by bootstrapping the data set 2,000 times for MP and NJ and 100 times for ML (Felsenstein, 1985). Bayesian analysis for 18s was conducted by running 1,000,000 generations using the Hasegawa, Kishino, and Yano + Invariable Sites + Gamma Distribution (HKY + I + G) model (Hasegawa *et al*., 1985). Trees were sampled every 100 generations with log-likelihood scores stabilized at approximately 6,000 generations. The first 5,000 trees of a possible 10,000 trees were discarded as burn-in. Analysis of *rbc*L sequences by Bayesian inference was performed running 1,000,000 generations using the General Time Reversible + Gamma Distribution, log-likelihood scores stabilized at approximately 4,500 generations and the first 5,000 of a possible 10,000 trees were discarded as burn-in. The 18s and *rbc*L gene sequences obtained from the newly sequenced specimens (Tables 7, 8) were deposited in GenBank.

Table 7 List of species used in 18s gene sequence analysis.

Species	Source	Accession Number	Reference
Ceratodictyon intricatum[1] (C. Agardh) R. E. Norris	GenBank	EF033594	5
Ceratodictyon spongiosum Zanardini	GenBank	AF117127	4
Ceratodictyon variabile[2] (J. Agardh) R. E. Norris	GenBank	AF085270	4
Champia affinis (Hook. *et*. Harv.) Harv.	GenBank	U23951	1
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212291	This study
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212292	This study
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF192576	6
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613311	6
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-194)	Guanica, PR	FJ212289	This study
Champia cfr. *parvula* (CLT-173)	La Parguera, PR	EF190546	6
Champia cfr. *parvula* (CLT-198)	Culebra, PR	EF613310	6
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF192577	6
Champia salicornioides Harv. (DLB-6873)	Guanica, PR	EF192579	6
Champia vieillardii Kütz. (CLT-165)	La Parguera, PR	EF192580	6
Champia vieillardii Kütz. (CLT-221)	La Parguera, PR	FJ173067	This study
Champia vieillardii Kütz. (CLT-286)	La Parguera, PR	FJ212290	This study
Chylocladia schneideri D.L.Ballant. (CLT-127)	GenBank	EF192578	6
Chylocladia verticillata(Lightf.) Bliding	GenBank	AF085263	4
Coelothrix irregularis (Harv.) Børgesen (CLT-171)	La Parguera, PR	EU086456	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-202)	La Parguera, PR	EU086457	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-203)	La Parguera, PR	EU086458	This study
Dictyothamnion saltatum A.Millar	GenBank	AF085264	4
Gastroclonium ovatum (Huds.) Papenfuss	GenBank	AF085265	4
Halymenia plana Zanardini	GenBank	U33133	3
Lomentaria australis (Kütz.) Levring	GenBank	U33134	3
Lomentaria baileyana (Harv.) Farl.	GenBank	L26194	2
Lomentaria rawiztcheri A.B. Joly (CLT-145)	La Parguera, PR	EU086460	This study
Lomentaria rawiztcheri A.B. Joly (CLT-183)	La Parguera, PR	EU670592	This study
Semnocarpa minuta Huisman, Foard *et* Kraft	GenBank	AF085271	4

[1] Reported as *Gelidiopsis intricata* in Le Gall and Saunders, 2007. [2] Reported as *Gelidiopsis variabilis* in Saunders *et a*l., 1999;
1 Millar *et al*.,1996; 2 Ragan *et al*., 1994; 3 Saunders and Kraft,1996;
4 Saunders *et al*., 1999;5 Le Gall and Saunders, 2007; 6 Ballantine and Lozada-Troche, 2008.

Table 8 List of species used in *rbc*L gene sequence analysis.

Species	Source	Accession Number	Reference
Ceratodictyon spongiosum Zanardini	GenBank	U21639	5
Ceratodictyon sp.[1]	GenBank	AY294357	3
Champia compressa Harv.	GenBank	AY294358	3
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212295	This study
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212296	This study
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF613316	4
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613317	4
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-194)	Guanica, PR	FJ179168	This study
Champia cfr. *parvula* (CLT-173)	La Parguera, PR	EU086464	4
Champia cfr. *parvula* (CLT-198)	Culebra, PR	EF613312	4
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF613314	4
Champia salicornioides Harv. (CLT-195)	Guanica, PR	EF613315	4
Champia vieillardii Kütz. (CLT-221)	La Parguera, PR	EU670596	This study
Champia vieillardii Kütz. (CLT-286)	La Parguera, PR	FJ212299	This study
Chylocladia schneideri D.L.Ballant. (CLT-127)	La Parguera, PR	EF613313	4
Coelothrix irregularis (Harv.) Børgesen (CLT-171)	La Parguera, PR	EU086459	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-215)	La Parguera, PR	EU670598	This study
Halymenia floresii (Clemente *et* Rubio) C. Agardh	GenBank	AB038603	2
Neogastroclonium subarticulatum[2] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	U04178	1
Neogastroclonium subarticulatum[3] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	AY294398	3
Lomentaria catenata Harv.	GenBank	U21642	3
Lomentaria hakodatensis Yendo	GenBank	AY294380	3
Lomentaria hakodatensis Yendo	GenBank	U04180	1

[1] Reporter as *Gelidiopsis* sp. in Gavio *et al*. (2005).
[2]Reported as *Gastroclonium coulteri* in Freshwater *et al*. (1994), now considered a synonym of *G. subarticulatum*.
[3]Reported as *Gastroclonium subarticulatum* by Gavio *et al*. (2005).
1 Freshwater *et al*., 1994; 2 Wang *et al*., 2000; 3 Gavio *et al*., 2005; 4 Ballantine and Lozada-Troche, 2008;
5 Unpublished GenBank sequence.

Results

Two sympatrically growing entities referable to *Champia parvula* were collected as seagrass epiphytes in Puerto Rico. These entities were clearly differentiated on the basis of branching origin as well as *rbc*L and 18s gene sequences (Figs. 35-36). One of the two entities exhibits branches originating from the nodal region (referred to herein as *Champia* cfr. *parvula*). These morphological differences correspond to molecular divergence observed between them. As it was seen that branching from between the septa differed from branching origin in the type specimen series (Fig. 19), the specimens displaying that character are treated below as a new species.

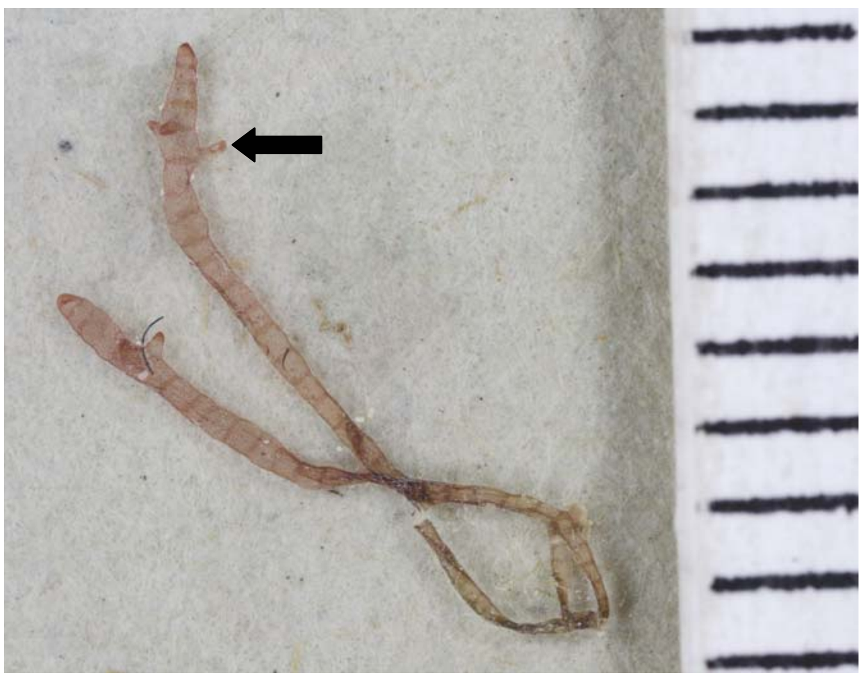

Fig. 19 *Champia parvula* (LD-26022). Close up of one of the four specimens collected by C. Agardh that were included on the type herbarium sheet showing alternate branching originating from the septa (arrow).

Champia* cfr. *parvula (Figs. 20-26)

Champia cfr. *parvula* is 2.5-11 cm in height with 1-6 axes arising from a common holdfast. The axes measure to 0.8-1.3 mm in diameter at the base and decrease in diameter distally to 0.5-0.6 mm towards the apices. Each axis has terete segments that are constricted at the septal regions at regular intervals (Fig. 20) Segments between diaphragms are 0.8-1.0 mm long. Axes possess rounded apices with a central cluster of 16-23 apical cells from which the longitudinal filaments develop (Fig. 21). A thick mucilage layer (30-35 µm thick) covers all branches (Fig. 20). Branching is initiated exclusively from the septa (Fig. 22) and has an opposite to alternate pattern. Transverse septa, one cell layer in thickness, occur in the region of constrictions. Septal cells measure 50-75 µm long and 50-60 µm in thickness. Small spherical darkly staining cortical cells are 10 µm in diameter, and abundantly located between the large cortical cells (Fig. 23). The cortex consists of a single layer of variably sized cells measuring from 50-125 µm wide by 25-55 µm long. Older parts of the plants do not possess wall thickening. Gland cells are cut off from longitudinal filaments and are spherical to ovoid in shape and measure to 10 µm in length. Urn-shaped cystocarps are conspicuous, measuring 430–600 µm in diameter and 500–730 µm in height (Fig. 24). These develop in the upper portions of thalli, arising at the mid- portions of segments. The cystocarp ostiole measures 130-210 µm in diameter. Carposporangia are irregular and measure 20-25 µm long by 15 µm wide. Carpospores are irregularly shaped and measure 37.5-70 µm long by 30-35 µm wide (Fig. 25). Spermatangia are ovoid to elliptical in shape, measuring 2.5 µm in diameter and 2.5-5.0 µm in length. They are borne in discrete clusters on the surface of the thallus arising from cortical cells. Gametophytes are dioecious. The tetrasporangia arise as a division product of a cortical cell.

Tetrasporangia are spherical in shape, tetrahedrally divided and measure 55-100 µm in diameter (Fig. 26).

Collections: D.L.B.-6143, Seaward Mario Reef, 14 m, Coll. David L. Ballantine, 3.ii.2004; D.L.B.-6875, Punta Brea, Guánica, 17 m, Coll. D.L.B. and H. Ruíz, 15.xii.2005; CLT-173, 1.5 km seaward Media Luna Reef, 17 m, Coll. H.R., 17.vii.2005; CLT-198, Culebra, mangrove roots, 2 m, Coll. H. Ruíz, 5.v.2006.

Herbarium specimens in MSM (All Puerto Rico) identified as *Champia parvula* corresponding to *Champia* cfr. *parvula*: MSM-2214, Dredged south of Salinas Bay, 20-25 m, Coll. Luis R. Almodóvar, 30.ix.1959; MSM-2176, Dredged off Bahia Salinas, west of Punta Brea, Guánica, 20 m, Coll. L.R.A., 28.ix.1959; MSM- 2534, Epiphyte on *Galaxaura* and *Digenea*, Depth (not included), Coll. Marshall A. Howe, 23.v.1903; MSM- 2675, Dredged off the mouth of Guánica Harbor, Puerto Rico, 7 m, Coll. M.A.H, 10.vii.1965; MSM-5577, Dredged in La Parguera, 15-21 m, Coll. L.R.A., 15.iv.1966; MSM-5688, 3 miles off Punta Brea Guánica, 21-30 m, Coll. L.R.A, 28.xi.1966; MSM-5821, Dredged off Punta Brea Guánica, 17 m, Coll. L.R.A., 17.i.1967; MSM- 6090, Dredged off Media Luna Reef, 17 m, Coll. L.R.A., 20.vi.1967; MSM- 6367, Dredged off Media Luna Reef, 17 m, Coll. L.R.A., 1.iii.1968; MSM-7308, Off Media Luna Reef, 17 m, Coll. L.R.A., 25.ix.1969; MSM-7298, Off Media Luna Reef, 17 m, Coll. L.R.A., 25.ix.1969; MSM- 7690, Dredged off Media Luna Reef, 17 m, Coll. L.R.A., 10.xi.1970; MSM- 7835, Dredged off Media Luna Reef, Coll. L.R. A., 11.iii.1971; MSM-7862, Dredged 2 miles off Media Luna Reef, Coll. L.R.A., 11.iii.1971; MSM-8792, North of Guayanilla Reef, Coll. L.R.A. and V.M. Rosado, 10.viii.1974; MSM-11182, Dredged off Media Luna, 17 m, Coll. L.R.A. and V.R. 19.ii.1974; MSM-11294, Dredged off Media Luna, 17 m, Coll. L.R.A. and V. R., 19.ii.1974; MSM-19649, 1.5 Km seaward Media Luna Reef, 17 m, Coll.

D.L.B., 14.i.1999; MSM-20714, Playa El Jobo, San Antonio, epiphytic on *Amphiroa fragilissima*, Coll. M. Díaz-Piferrer, 30.vi.1962; MSM-20715, Playa El Combate de Cabo Rojo, Coll. M.D.-P., 26.ii.1964; MSM-21648, 1.5 Km seaward Media Luna Reef, 17 m, Coll. D.L.B. and H. Ruíz, 24.ix.2007; MSM-21722, Seaward Margarita Reef, La Parguera, 17 m, Coll. H.R., 24.x.2007; MSM- 21745, Punta Brea, Guánica, 17 m, Coll. D.LB. and H.R., 15.xii.2005.

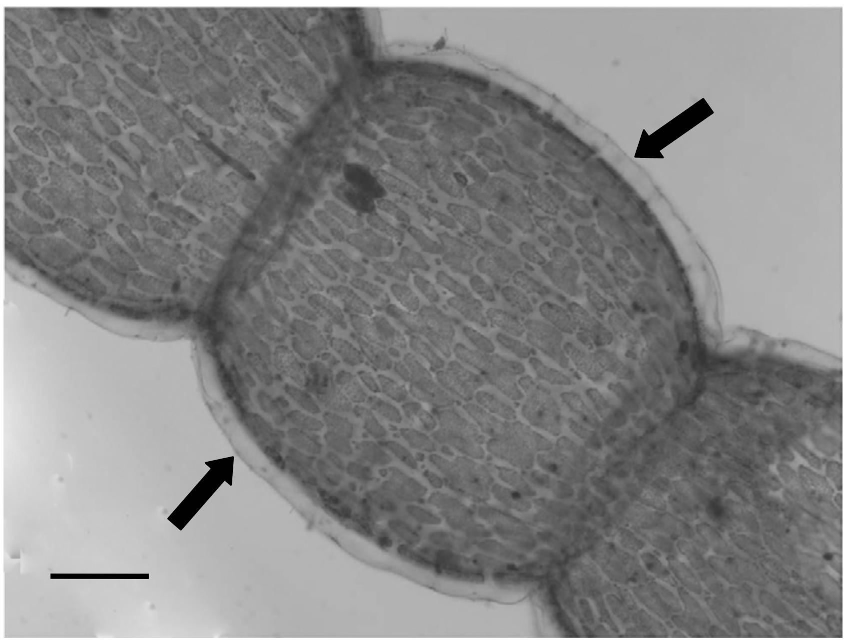

Fig. 20 *Champia* cfr. *parvula* (D.L.B.-6875). Thallus with constristed septa and a mucilage layer covering the segments (arrows). Scale bar = 800 µm.

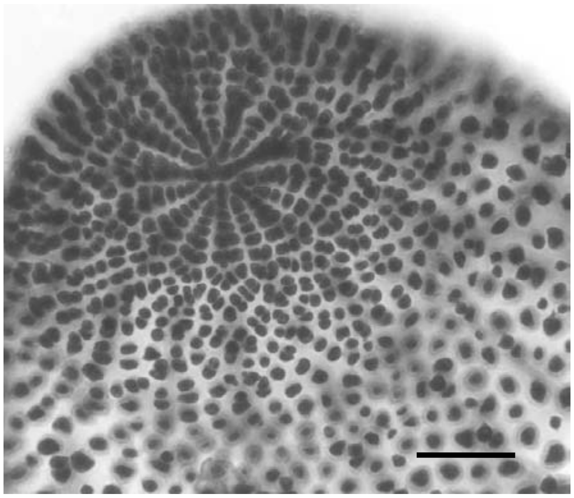

Fig. 21 *Champia* cfr. *parvula* (D.L.B.-6143). Branch apex showing cluster of apical cells. Scale bar = 20 µm.

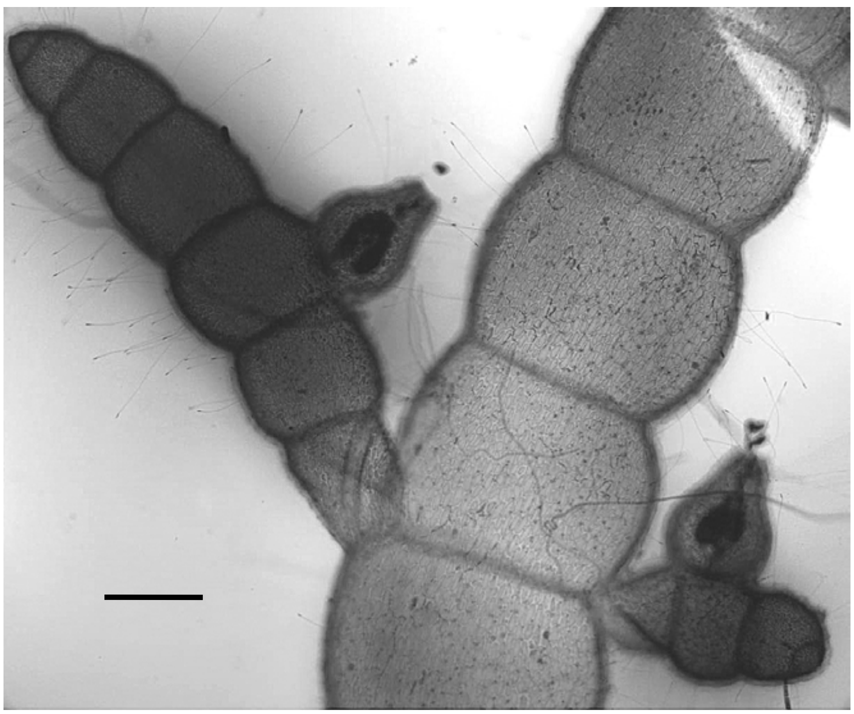

Fig. 22 *Champia* cfr. *parvula* (D.L.B.-6875). Plant with atypical opposite branching originating from the septa. Scale bar = 1000 µm.

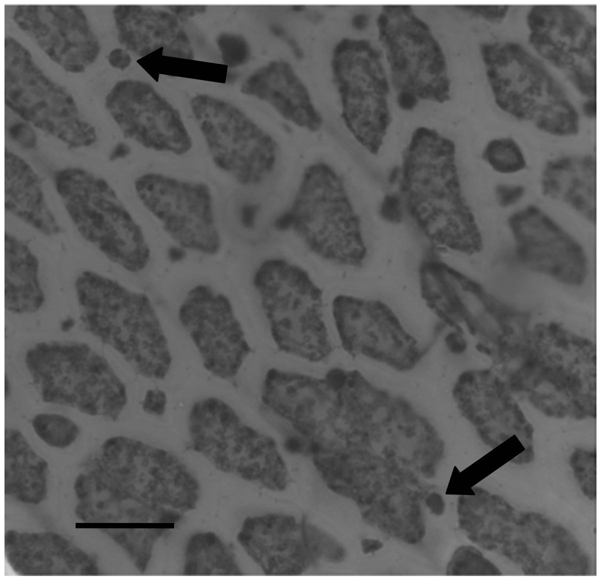

Fig. 23 *Champia* cfr. *parvula* (D.L.B.-6843). Cortical and small darkly staining cells (arrows). Scale bar = 20 µm.

Fig. 24 *Champia* cfr. *parvula* (D.L.B.-6875). Mature urn-shape cystocarp with carpospores. Scale bar = 500 µm.

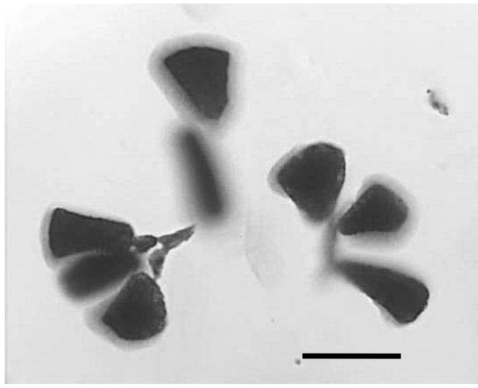

Fig. 25 *Champia* cfr. *parvula* (D.L.B.-6875). Irregularly- shaped carpospores. Scale bar = 40 µm.

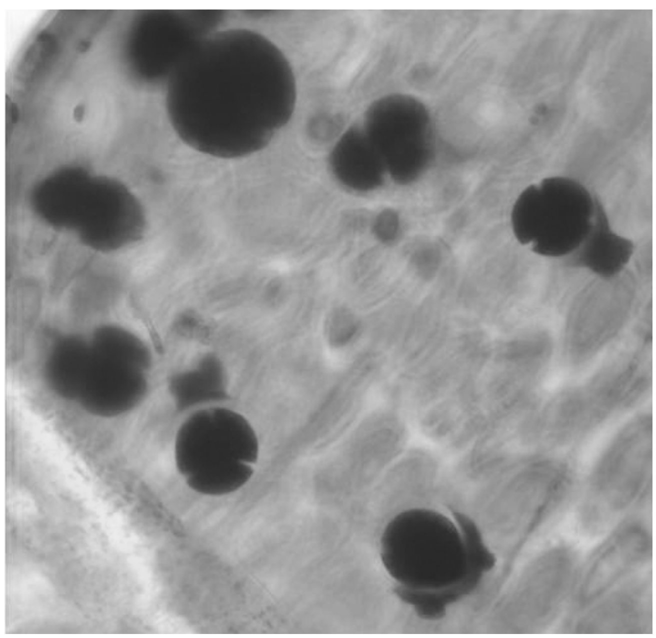

Fig. 26 *Champia* cfr. *parvula* (D.L.B.-6143). Spherical tetrahedrally divided tetrasporangia. Scale bar = 50 µm.

***Champia* sp. nov.** (Figs. 27-34)

The new species was collected on *Thalassia testudinum* Banks *ex* Koenig in seagrass beds at a depth of 1-2 m and was initially identified as *Champia parvula* (Fig. 27). *Champia* sp. nov. is 1-4.5 cm in height with 4-7 axes arising from a common holdfast (Fig. 28). The axes measure to 500 µm in diameter at the base and increase in diameter distally to 1-1.3 mm before decreasing in breadth at the apices. Each axis has 7-9 terete segments that are constricted in septal regions at regular intervals. Segments between diaphragms are 1-1.3 mm long. Axes possess rounded apices with a central cluster of 15-20 apical cells from which the longitudinal filaments develop (Fig. 29). A thick mucilage layer (30-35 µm thick) covers all branches. Branching is initiated between the septa in an opposite pattern (Fig. 30). Transverse septa that are one cell layer in thickness occur in the region of constrictions. Small darkly staining cortical cells are 10–15 µm in diameter, and irregularly but abundantly located between the large cortical cells (Fig. 31). The cortex consists of a single layer of irregularly shaped cells measuring from 20-25 µm wide by 45-75 µm long. Septal cells measure up to 125 µm long and to 75 µm in thickness. Gland cells are cut off from longitudinal filaments and possess a spherical to ovoid shape and measure 10-12.5 µm in length. Urn-shaped cystocarps are conspicuous measuring 490–670 µm in diameter and 500–700 µm in height (Fig. 32). These develop in the upper portions of thalli, arising at the mid portions of segments. The cystocarp ostiole measures 150-300 µm in diameter. Carposporangia are irregularly shaped and measure 55 µm long by 40 µm wide. Individual elongated spermatangial mother cells (SMC's) (6-7) originate from a common cortical cell and are radially arranged (Fig. 33B). Spermatangia are cut off from SMC's forming clusters on the thallus surface (Fig. 33), are ovoid to elliptical in shape and measure to 2.5 µm in diameter and to 2.5-5.0 µm in length (Fig 33B). Gametophytes are monoecious. The tetrasporangia arise as a division product of a cortical cell. Tetrasporangia are spherical in shape, tetrahedrally divided and measure 40-60 µm in diameter (Fig. 34). A morphological comparison between *Champia* sp. nov. and other selected *Champia* species reported for the Caribbean is presented in Table 9.

Collections: D.L.B.-2023, Seaward Margarita Reef, 24 m, Coll. D.L.B., 3.vii.1985; D.L.B.-2091, 1.5 km seaward Media Luna Reef, 17 m, Coll. D.L.B., 5.viii.1985; C.L.T.-214, Cayo Caracoles, La Parguera, epiphytic on *Thalassia testudinum*, 1.5 m, 6.ix.2007, Coll. Chad Lozada-Troche and I. López.

Herbarium specimens in MSM (all Puerto Rico) identified as *Champia parvula* that correspond to the new species: MSM-1787, Dredged off El Faro, Cabo Rojo, 30-35 m, Coll. L.R.A., 3.ix.1959; MSM-2099, Dredged Cayo Margarita, La Parguera, 24 m, Coll. L.R.A., 17.ix.1959; MSM-2148, Dredged south Cayo Margarita, La Parguera, 20-25 m, Coll. L.R.A., 24.ix.1959; MSM-2623, beach cast, Santurce, Puerto Rico, Coll. M.A.H., 16.vi.1915; MSM-3395, Guánica, on rocks, 15 m Coll. L.R. A., 28.iii.1962; MSM-5843, Off Punta Brea Guánica, epizooic on *Strombus Gigas*, 17 m, Coll. L.R.A.; MSM-7209, Algal traps 1.5 km seaward Media Luna Reef, 17 m, Coll. V.M.R. and Juan J. Irrizarry, 9.iv.1969; MSM-14541, Poza de las Mujeres, Manatí, Puerto Rico, Coll. M.D.-P., 8.vi.1962; MSM-14543, Playa el Jobo San Antonio, Puerto Rico, epiphytic on *Heterosiphonia gibbesii*, 1-1.5 m, Coll. M.D.-P., 11.iv.1963; MSM-17740, Playa Tamarindo, Guánica, 1-1.5 m, epiphytic on *Udotea flabellum*, Coll. M.D.-P., 7.ii.1959.

Fig. 27 *Champia* sp. nov. (CLT-214). Habit of plant growing as an epiphyte on *Thalassia testudinum.* Scale bar = 50 mm. (Photo taken by Héctor Ruíz).

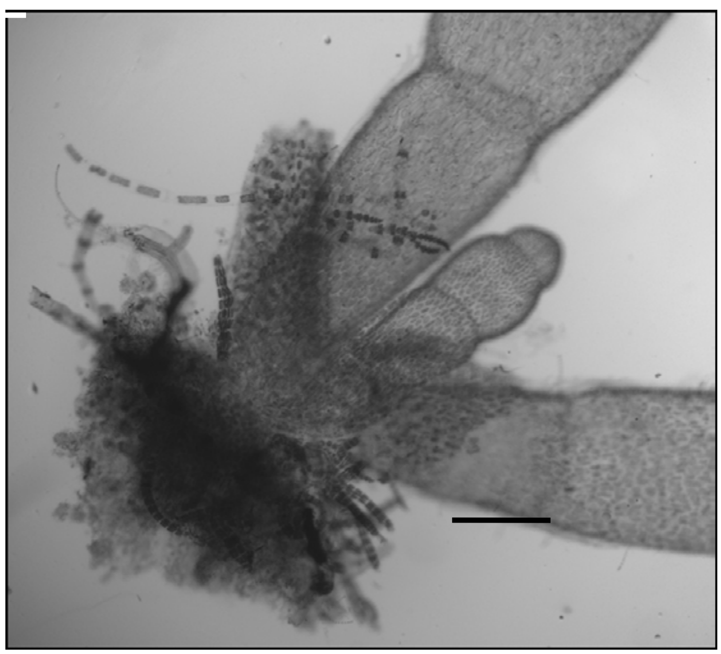

Fig. 28 *Champia* sp. nov. (CLT-214). Multiple axes arising from a common holdfast. Scale bar = 500 µm.

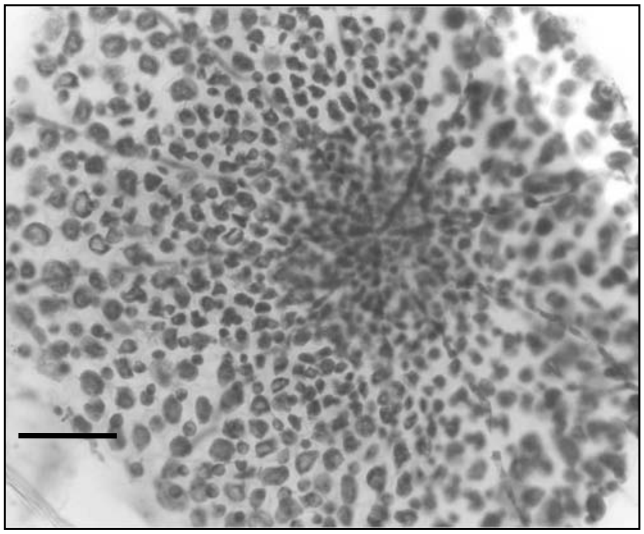

Fig. 29 *Champia* sp. nov. (CLT-214). Branch apex showing cluster of apical cells. Scale bar = 20 µm.

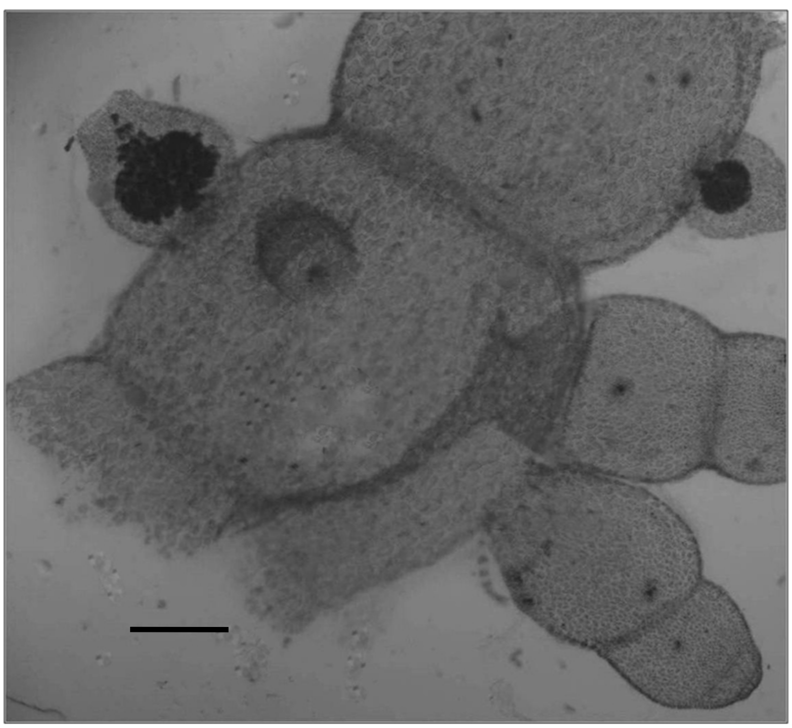

Fig. 30 *Champia* sp. nov. (CLT-214). Cystocarpic plant with branching originating between the septal region. Scale bar =1000 µm.

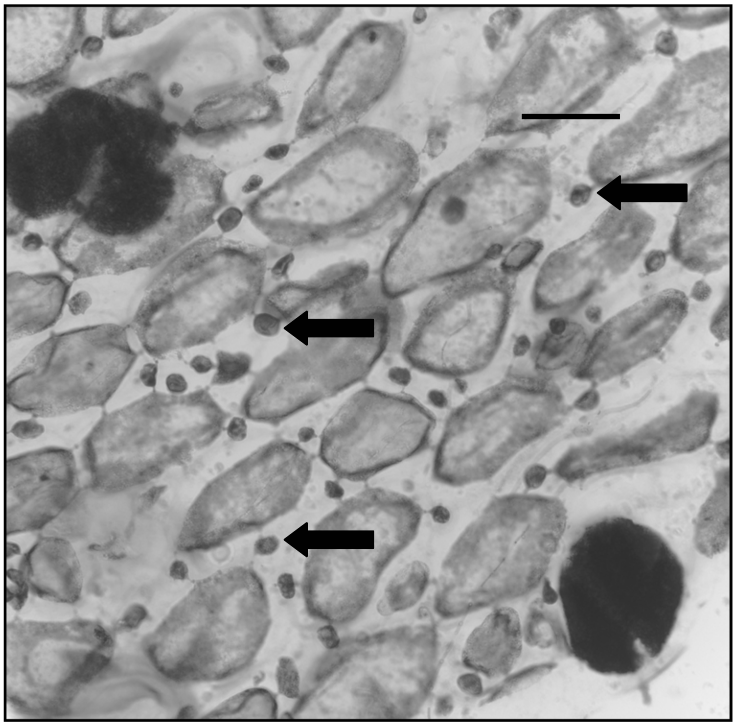

Fig. 31 *Champia* sp. nov. (CLT-214). Cortical and small darkly staining cells (arrows). Scale bar = 20 µm.

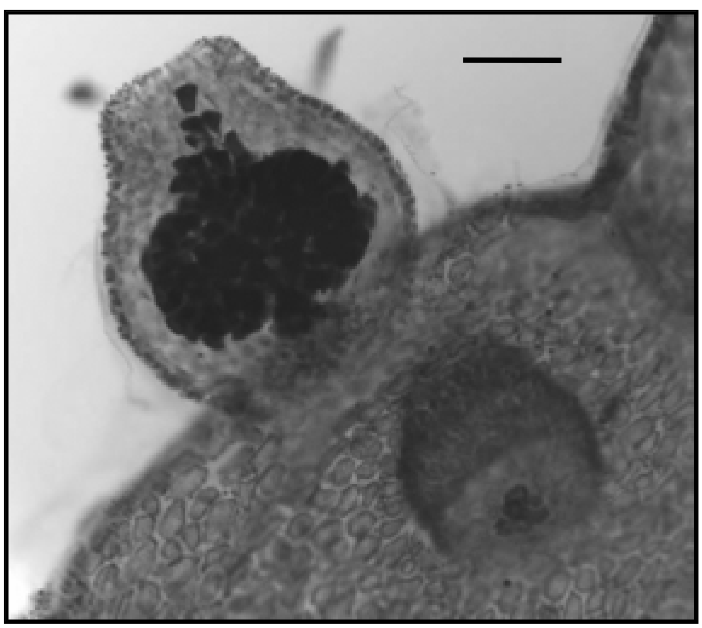

Fig. 32 *Champia* sp. nov. (CLT-214). Mature urn-shape cystocarp with carpospores. Scale bar = 700 µm.

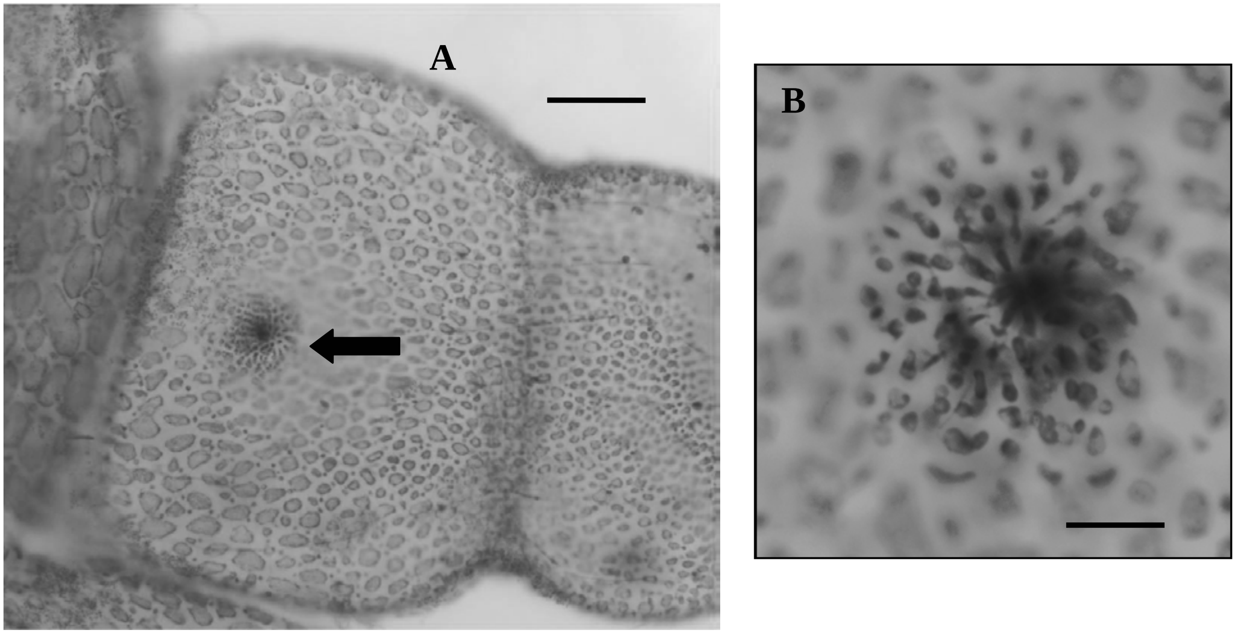

Fig. 33 Champia sp. nov. (CLT-214) A) Branch showing spermatangial sorus (arrow). Scale bar = 100 µm, B) Close up of spermatangial cluster. Scale bar = 2 µm.

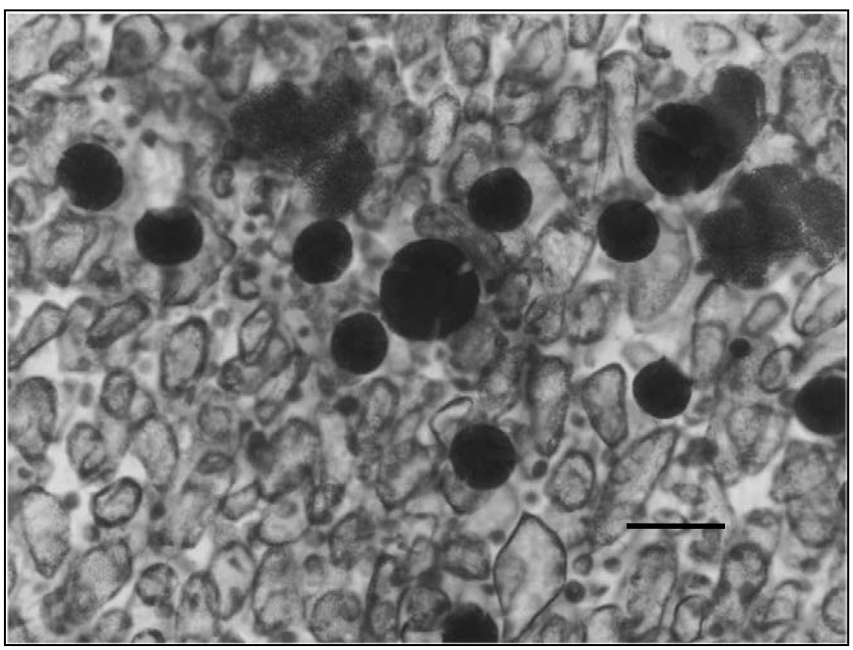

Fig. 34 *Champia* sp. nov. (CLT-214). Spherical tetrahedrally divided tetrasporangia. Scale bar = 50 µm.

Table 9 Comparison between *Champia* sp. nov. and seleted *Champia* species reported from the Atlantic and the Caribbean.

Characteristics	*Champia* sp. nov.	*C. parvula*	*C. minuscula*	*C. harveyana*	*C. salicornioides*	*C. vieillardii*
Thallus shape	Terete	Terete	Terete	Terete	Terete	Compressed
Branch tips	Obtuse	Obtuse	Obtuse	Obtuse	Obtuse	Obtuse
Size (height)	1-4.5 cm	2-11 cm	Up to 2 cm	8-15 cm	8-13 cm	1-3 cm
Branching pattern	Opposite	Alternate	Alternate	Irregular to opposite to verticillate	Irregular to opposite to verticillate	Irregular to alternate
Branches diameter	0.5-1.2 mm	0.5-2.0 mm	0.8-2.0 mm	1.8-2.5 mm	2.6-3.3 mm	0.7-1.5 mm
Branching Origin	Between the nodal region	Nodal region	Nodal region	Nodal region	Between the nodal region	Between and from the nodal region
Axes from holdfast	4-7	1 to many	Not specified	2-6	2-4	1
Gametophytes	Monoecious	Dioecious	Not specified	Dioecious	Dioecious	Dioecious
Cystocarp shape, ostiole	Urn-shape and ostiolate	Urn-shape and ostiolate	Globose and ostiolate	Conical to truncate-conical and ostiolate	Conical to truncate-conical and ostiolate	Urn-shape and ostiolate
Cystocarp diameter	670 µm	1000 µm	450-600 µm	750-950 µm	800-950 µm	600 µm
Tetrasporangial division	Tetrahedral	Tetrahedral	Tetrahedral	Tetrahedral	Tetrahedral	Tetrahedral
Tetrasporangial size (diameter)	40-60 µm	55-120 µm	51-75 µm	70 µm	70 µm	80-100 µm

Table 9 cont.

Characteristics	*Champia* sp. nov.	*C. parvula*	*C. minuscula*	*C. harveyana*	*C. salicornioides*	*C. vieillardii*
Tetraspoporangial shape	Spherical	Globose	Spherical	Obovate	Spherical to obovate	Spherical
References	This study	Reedman and Womersley (1976); Irvine and Guiry (1983)	Joly *et al*. (1965)	Ballantine and Lozada-Troche (2008)	Ballantine and Lozada-Troche (2008)	Bula-Meyer (1997); Masuda et al., (2001); Dawes and Mathieson (2008);

Molecular analysis

DNA sequences from 18s and *rbc*L genes representing the families Champiaceae and Lomentariaceae within the order Rhodymeniales were analyzed to determine phylogenetic relationships between the new *Champia* species and the other Champiaceae members. Thirty-one 18s sequences (Table 9) were used to construct a phylogenetic tree (Fig. 35). Seven *Champia* species were included in the analysis. Five new small ribosomal subunit gene sequences were generated from four *Champia* species and two from *Lomentaria rawitzcheri* A.B.Joly. Length of new 18s sequences varied from 1699 to 1760 bp. Small ribosomal subunit sequence divergence between *Champia* sp. nov. and *Champia* cfr. *parvula* was 4.4% and among Champiaceae members varied from 0.88-7.5%.

Twenty-three *rbc*L sequences (Table 10) were tested to verify the results obtained from the 18s analysis. Seven new *rbc*L sequences of approximately 1,300 bp in length, representing five *Champia* species, were also included in the analysis. Sequence divergence between *Champia* sp. nov. and *Champia* cfr. *parvula* was 2.73%. Intraspecific *rbc*L sequence divergence between *Champia* species had a mean value of 7.27%, while divergence among genera included in the Champiaceae was 10.08%. According to 18s and *rbc*L results (Fig. 35 and 36) the new *Champia* species appears to be most closely related to *Champia* cfr. *parvula*, *C. compressa*, *C. vieillardii*, and *C. affinis* (Hooker *et* Harvey) Harv. with moderate to highly supported bootstrap and posterior probability values. The phylogram inferred from *rbc*L sequence data (Fig. 36) indicates a clear separation between the *C. compressa* and *C. vieillardii* with a mean sequence divergence of 6.35% between them. In addition, highly supported 18s sequence analysis revealed that *Lomentaria baileyana* (Harv.) Farl., *L. rawitscheri* A.B.Joly, and *L. australis* (Kütz.) Levring represent sister but distinct taxa (Fig. 35). Sequence divergence between them varied from 0.36 to 0.77% revealing species separation and providing further evidence to maintain *L. baileyana* and *L. rawitzcheri* as separate species.

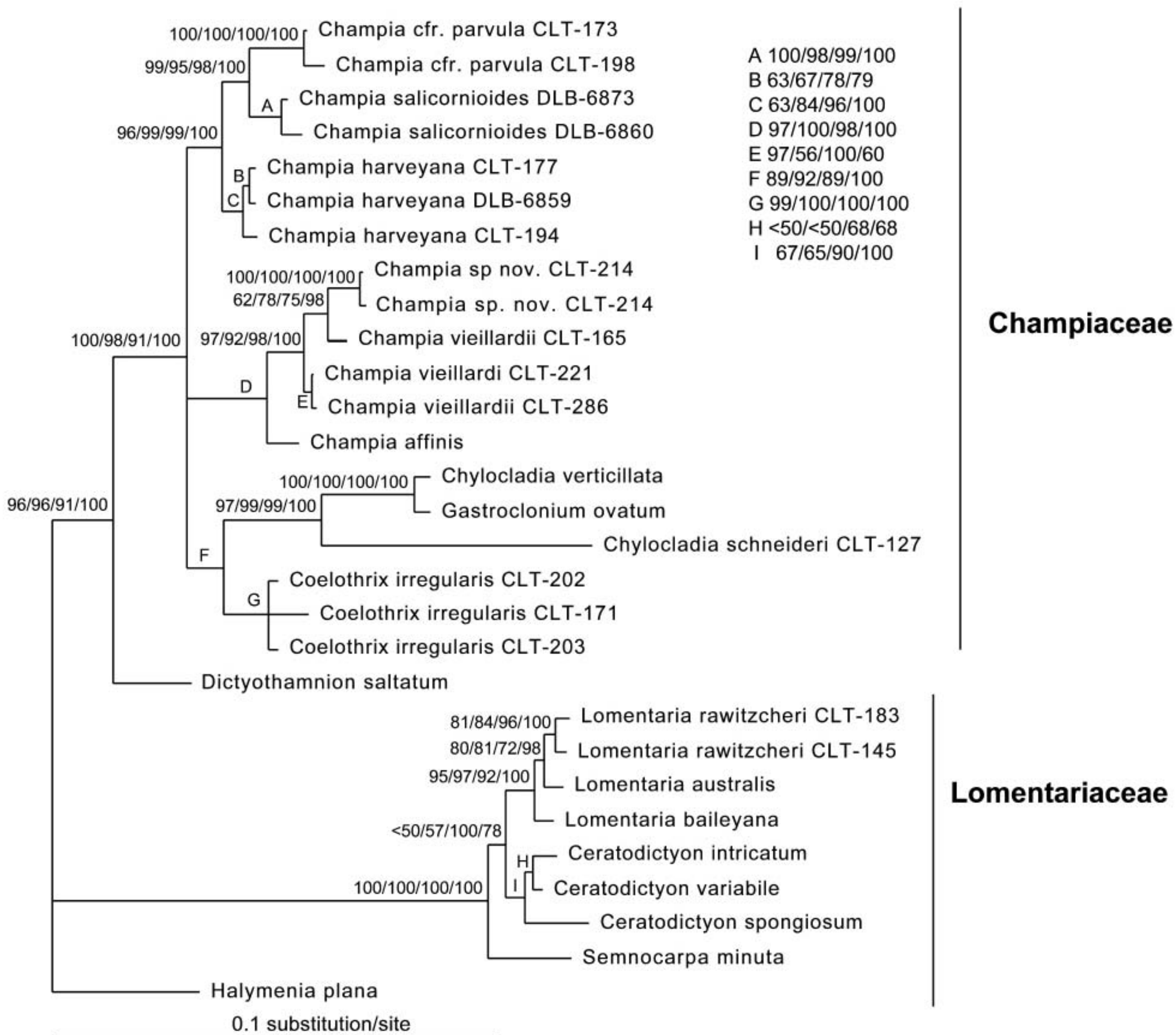

Fig. 35 Small ribosomal subunit sequences phylogram generated by Bayesian Analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Likelihood,100 replicates; Maximum Parsimony, 2000 replicates; Neighbor Joining, 2000 replicates; Bayesian posterior probabilities, 1,000,000 generations.

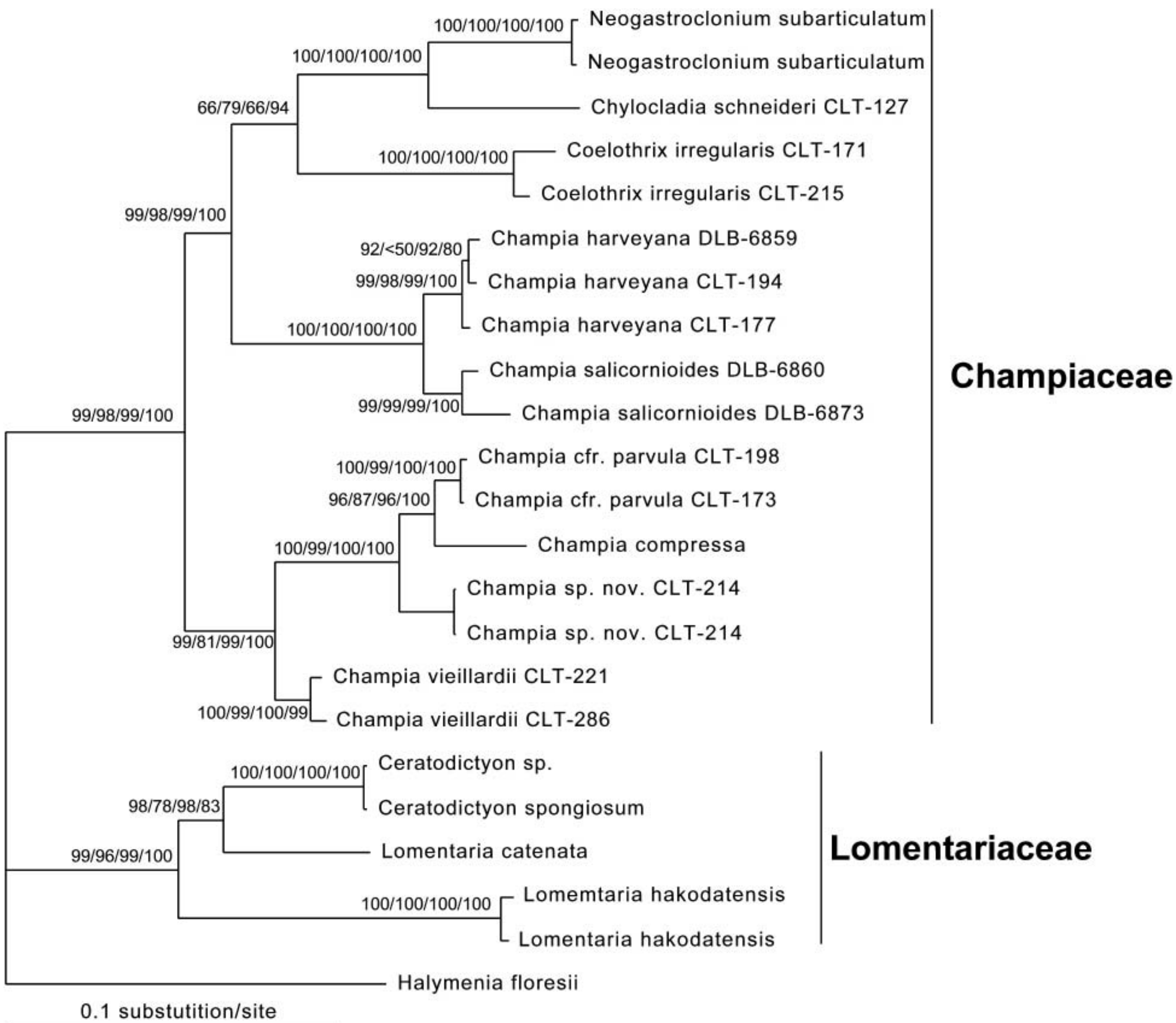

Fig. 36 Rubisco large subunit (*rbc*L) sequences phylogram inferred from Bayesian analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Likelihood, 100 replicates; Maximum Parsimony, 2000 replicates; Neighbor-Joining, 2000 replicates; Bayesian posterior probabilities, 1,000,000 generations.

Discussion

Ballantine and Lozada-Troche (2008) erected a new species, *Champia harveyana* D.L.Ballant. *et* C.Lozada which had previously been referred to *C. salicornioides* Harv. The principal morphological differentiating characteristic between the two species was branching origin, from the septal region in the former and between the nodal septa in the latter. The consistent difference in branching origin was shown to be correlated to differences in *rbc*L and 18s gene sequences (Ballantine and Lozada-Troche 2008). The original description of *Champia parvula C.*Agardh (1824), as *Chondria parvula* C. Agardh, did not include details concerning branching origin. Nevertheless, examination of digital photographs taken of the type collection (in LD) (Fig. 19) clearly shows branching from the nodal septa which differs from that in the new species. The criteria of branching origin applied to *Champia harveyana/salicornioides* similarly argues for the differentiation of *Champia* nov. sp. from *Champia parvula*.

The new species shares a number of features with the European accounts of *C. parvula* including general appearance, conspicuous similarly shaped cystocarps, and size and shape of tetrasporangia. However, the two species may be externally differentiated with respect to branching origin, from between the septa in the new species and from the septal region in *C. parvula* (Irvine and Guiry, 1983). They also differ in the number of axes arising from the holdfast (4-7 vs 1 or more) (Irvine and Guiry, 1983). Morphometric differences between the new species and *C. parvula* include smaller cystocarps (670 µm vs 1000 µm), shorter segment length (1.0-1.3 vs 1.0-5.0 mm), smaller surface cells (20-25 µm x 45-75 µm vs 22-38 µm x 50-130 µm) and smaller tetrasporangia (40-60 µm vs 50-100 µm) (Irvine and Guiry, 1983). Gametophytes in the new species are monoecious, while *C. parvula* has been reported as being dioecious (Irvine and Guiry, 1983).

Champia sp. nov. resembles *C. minuscula* Joly *et* Ugadim with respect to size, terete thalli and obtuse branch tips. The species can be differentiated on the basis of branching pattern, being opposite in the former and alternate in the latter. In addition, the new species has smaller branch diameter (0.5-1.3 vs 0.8-2.0 mm), smaller cortical cells (20-25 x 45-75 vs 41-100 x 48-55 µm), and smaller tetrasporangia (40-60 µm x 51-75µm) (Joly *et al*., 1965). Finally, cystocarps in the new species are urn-shaped, as opposed to globose in *C. minuscula*. *Champia* sp. nov. also resembles *Champia feldmanii* Díaz-Piferrer in overall size, frond diameter and internodal development of cystocarps. The principal differences between *C. feldmanii* and the new species include hamate branch tips vs obtuse in the former, branching pattern (irregularly alternate vs opposite), larger and paired cystocarps vs smaller solitary cystocarps in the new species, and larger tetrasporangia (up to 75 µm vs 40-60 µm) (Díaz-Piferrer, 1977).

The entity treated as *Champia* cfr. *parvula*, from Puerto Rico, bears many similarities to the accounts of *Champia parvula* from the eastern Atlantic including branches originating from the septa, opposite to alternate branching pattern, in addition to morphometric measurements. Branching pattern is reported to be variable in *Champia parvula*: opposite to alternate (Schneider and Searles, 1991), or mostly alternate (Taylor, 1960; Irvine and Guiry, 1983; Womersley, 1996, Littler and Littler, 2000; Dawes and Mathieson, 2008; Littler *et al*., 2008). These differences are a result of either morphological plasticity or a reflection that various entities referred to *Champia parvula* have been characterized. In one of the type specimens (C.Agardh 26022), branching in the same individual was both opposite and alternate (Fig. 19).

Examination of herbarium specimens in MSM reveals that the entity *Champia* cfr. *parvula* is more common than *Champia* sp. nov. in Puerto Rico. Morphological characters between east and west Atlantic Champia parvula specimens overlap sufficiently that they cannot be distinguished at this time. Therefore, the name *Champia parvula* is retained for the western Atlantic, including Caribbean specimens. Nevertheless such assignment is tentative until material from the type locality can be sequenced and compared with west Atlantic populations. An extensive biogeographic study using molecular markers (e.g. *rbc*L) will allow clarification with certainty whether *C. parvula* is represented in Puerto Rico or in the western Atlantic.

If Irvine and Guiry's (1983) speculation that *C. parvula* is limited to the eastern Atlantic is correct, that would leave Puerto Rican and North American specimens of *Champia* cfr. *parvula* as undescribed entities, although these appear to be conspecific being similar in thallus size (2.5-11 cm), branch diameter (0.5-2.0 mm) and with opposite to mostly alternate branching. Reedman and Womersley (1976) reported that Australian *C. parvula* possessed wall thickenings and felt that their specimens agreed well with type collections. As Puerto Rican *Champia* cfr. *parvula* does not possess wall thickenings, this would appear to indicate that multiple species referred to C. parvula are present. Obviously this character needs to be evaluated in material from the type locality in addition to North America in addition to the sequence information indicated above.

The new *Champia* species produces tetrasporangia as a division product from a cortical cell. This was also observed for *Champia harveyana* (Ballantine and Lozada-Troche, 2008) and *Coelothrix irregularis* (as discussed in chapter 4). Tetrasporangial origin for the family Champiaceae and the genus *Champia* has been reported to be by transformation of a cortical cell (Reedman and Womersley, 1976) as well as being in an intercalary position (Irvine and Guiry, 1983; Saunders *et al*., 1999). Furthermore, the tetrasporangia are in a terminal position in the new *Champia* species, *Champia harveyana* and *Coelothrix irregularis.* Clearly this character needs to be re-examined in other members of the Champiaceae. Saunders *et al*. (1999)

emphasizes it that is necessary to observe early stages in sporangial differentiation as tetrasporangial position may be misinterpreted in mature developmental stages. Most rhodymenialean, genera possess terminal tetrasporangial disposition (i.e. Faucheaceae, Lomentariaceae, Fryeellaceae and rarely Rhodymeniaceae). Conversely, most rhodymeniacean genera possess tetrasporangia in an intercalary position. Those genera include *Chamaebotrys* and *Halichrysis* (Huisman, 1996; Saunders *et al*., 1999, 2006). The possession of terminal tetrasporangial in the Champiaceae members discussed here suggests that this character may be more common in the family than is currently appreciated. Pending broader examination, a redefinition of the family with respect to tetrasporangial origin and placement may be required.

Champia vieillardii and *C. compressa* share various morphological characters including overall size, compressed to flattened axes, and branching pattern. Thalli in *C. vieillardii* are considered to be more strongly compressed than those presented by *C. compressa* (Dawson, 1954). The two species may also be externally differentiated with respect to constrictions associated with diaphragms, present in *C. compressa* and absent in *C. vieillardii*. Also, diaphragms in *C. vieillardii* are only 2-4 cells in length, while in *C. compressa* are 8-10 cells in length (Bula-Meyer, 1997; Millar, 1990; Masuda *et al*., 2001). The location of longitudinal filaments can also be used to differentiate the species. *Champia vieillardii* possess filaments peripherally distributed, while those of *C. compressa* are found in the center of the thallus. Sequence divergence of *rbc*L data from both taxa (6.35%) provided further support for species differentiation. According to the phylogram inferred from *rbc*L data, *C. vieillardii* represents a sister taxon of the clade comprising *Champia parvula* and *Champia* sp. nov. and *C. compressa* (Fig. 36).

Chapter 6: A new red algal genus (Rhodymeniaceae, Rhodymeniales) from Puerto Rico

Summary – Recent collections in cryptic habitats from coral reefs in Puerto Rico have yielded specimens of a minute alga strongly resembling *Chrysymenia* on the basis of morphological characters. The alga reaches only 7 mm in diameter and is characterized by iridescent thalli with a vesiculate globose appearance. Thalli lack septa, and internal filaments are only rudimentary. The vesicle wall consists of a single layer of medullary cells and two cortical cell layers. Cystocarps protrude slightly and measure 270-320 um in diameter. Intercalary tetrasporangia, measuring to 22.5 µm in length and 20 µm in width, develop from inner cortical cells, and are cruciately divided. The spermatangial mother cells are produced in periclinal series, which themselves divide to produce spermatangia. Molecular evidence suggests that the species is a member of the *Erythrocolon* group within the Rhodymeniaceae.

Introduction

The family Rhodymeniaceae is the largest of the six families currently included in the order Rhodymeniales (Womersley, 1996; Le Gall *et al*., 2008) and has been the subject of a number of studies in recent years. It is through the advent of molecular techniques that many classically held concepts of generic relationships in the family have proven to be false. Nevertheless, the phylogenetic position of some genera currently classified within the family remains unresolved (Saunders *et al*., 1999; Afonso-Carillo *et al*., 2006). For example, the simple morphological criteria as applied to separation of *Chrysymenia* from *Botryocladia* are currently being questioned with the recognition that the genera are not monophyletic and represent heterogenous assemblages (Saunders *et al*. 1999; Wilkes *et al*., 2006). Furthermore, hollow vesicle walls of various genera assigned to the Rhodymeniaceae including *Chrysymenia*, *Botryocladia, Coelarthrum, Erythrocolon, Chamaebotrys* and *Gloiosaccion* are very similar (Huisman, 1996), making the problem even more complex. In fact, systematic difficulties within the Rhodymeniaceae (Rhodymeniales) as a whole have been well documented (Huisman, 1995, 1996; Saunders & Kraft, 1994, 1996; Saunders 2004).

The *Erythrocolon* group as described by Kylin (1956) was characterized by algae possessing hollow septate thalli with gland cells. The group at that time included: *Erythrocolon*, *Coelarthrum*, and *Fryeella*. *Fryeella*, however, has recently been transferred to the Fryeellaceae by Le Gall *et al*. (2008), differing from the remaining genera in the group by development of tetrasporangial nemathecia. *Coelarthrum cliftonii* (Harv.) Kylin is the only representative from the *Erythrocolon* group known from the Caribbean (Wynne 2005), including Puerto Rico (Ballantine and Aponte, 2002b).

Recent collections from coral reef habitats at 6-23 m depths offshore from La Parguera, Puerto Rico, have yielded specimens of a diminutive species which, based on classical vegetative morphological features, was originally considered to be *Chrysymenia*. The new genus is cryptic in habitat, growing largely hidden within crevices and difficult to access reef interstices.

Materials and Methods

Specimens were collected by SCUBA diving (Table 10) and were preserved in 10% Formalin/seawater or desiccated in silica gel for molecular studies. Authority designations are according to Brummitt and Powell (1992). Total DNA extraction, 18s gene amplification, and sequencing were performed as detailed in Chapter 3. The phylogenetic reconstruction for the new genus was performed using the MP, ML, and NJ algorithms as implemented in PAUP* (v 4.1b10) (Swofford, 2002). Bayesian inference was generated with Mr.Bayes (v.3.1.2) from 18s sequences (Huelsenbeck and Ronquist, 2001). The optimal model determined by Modeltest (Posada and Crandall, 1998) for 18s analysis was the GTR + I + G evolutionary model (General Time Reversal + Invariable sites + Gamma distribution) (Lanave *et al*. 1984; Rodríguez *et al*. 1990). The assumed nucleotide frequencies were: A= 0.2433, C= 0.2106, G= 0.2867, T= 0.2583. The assumed substitution rate matrix was: A-C substitutions = 0.9543, A-G= 3.4705, A-T= 1.2427, C-G= 0.5962, C-T= 4.3820, G-T=1.0000; proportion sites assumed to be invariable= 0.6729; rates for variable sites were assumed to follow gamma distribution with shape parameter= 0.6076. The robustness of the data was determined by bootstrapping the data set (Felsenstein, 1985) 100 times for ML and 2,000 times for MP and NJ. Bayesian analysis for 18s sequences was conducted using evolutionary model HKY + G + I model (Hasegawa, Kishino, and Yano + Invariable sites + Gamma distribution) (Hasegawa *et al*., 1985) and running 1,200,000 generations. Trees were sampled every 100 generations with log-likelihood scores stabilized at approximately 4,000 generations. The first 4,500 of a possible 10,000 trees were discarded as burn-in. Sequences from the newly sequenced species are deposited in GenBank.

Table 10 Species used in 18s analysis.

Species	Source	Accession Number	Reference
Botryocladia ebriosa A.Millar	GenBank	AF085255	3
Botryocladia iridescens D.L. Ballant. *et* Ruiz (CLT-147)	La Parguera, PR	EF690265	This study
Botryocladia iridescens D.L. Ballant. *et* Ruiz (CLT-166)	La Parguera, PR	EF690266	This study
Botryocladia leptopoda (J.Agardh) Kylin	GenBank	DQ343160	4
Botryocladia occidentalis (Børgesen) Kylin (CLT-172)	Isabela, PR	EU086462	This study
Botryocladia sonderi P.C. Silva	GenBank	AF085256	3
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott (CLT-144)	La Parguera, PR	EU690268	This study
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott (CLT-178)	La Parguera, PR	EU670591	This study
Botryocladia wynnei D.L. Ballant. (CLT-176)	Lab culture	EF690267	This study
Botryocladia wynnei D.L. Ballant. (CLT-218)	La Parguera, PR	EU670589	This study
Chamaebotrys sp. (CLT-231)	La Parguera, PR	EU715131	This study
Chamaebotrys sp. (CLT-232)	La Parguera, PR	EU715132	This study
Coelarthrum cliftonii (Harv.) Kylin (CLT-197)	La Parguera, PR	EU086465	This study
Coelarthrum cliftonii (Harv.) Kylin (CLT-235)	La Parguera, PR	EU670594	This study
Coelarthrum cliftonii (Harv.) Kylin (CLT-236)	La Parguera, PR	EU670595	This study
Coelarthrum opuntia (Endl.) Børgesen	GenBank	AF085258	3
Chrysymenia agardhii Harv. (CLT-142)	La Parguera, PR	EF690262	This study
Chrysymenia nodulosa J.N.Norris *et* D.L.Ballant. (CLT-181)	La Parguera, PR	EF690291	This study
Chrysymenia ornata (J.Agardh) Kylin	GenBank	AF085257	3
Erythrocolon podagricum (Harv.) J. Agardh	GenBank	U23953	1
Faucheopsis coronata (Harv.) Kylin	GenBank	AF085268	3
Fryeella gardneri (Setchell) Kylin	GenBank	AF085273	3
Gen. et. sp. nov. (CLT-147)	La Parguera, PR	EF690263	This study
Gen. et. sp. nov. (CLT-156)	La Parguera, PR	EF690264	This study
Gloiocladia furcata (C. Agardh) J. Agardh	GenBank	DQ790749	5
Gloiocladia laciniata[1] (J. Agardh) Sánchez *et* Rodríguez-Prieto	GenBank	AF085266	3
Gloiocladia repens (C. Agardh) Sánchez *et* Rodriguez-Prieto	GenBank	DQ790750	5
Gloiocladia repens[2] (C. Agardh) Sánchez *et* Rodriguez-Prieto	Genbank	AF085267	3
Gloioderma atlantica Searles (CLT-163)	La Parguera, PR	AF085259	This study
Gloioderma fruticulosum (Harv.) De Toni	GenBank	U33131	2
Gloiosaccion brownii Harv.	GenBank	AF085259	3
Halymenia plana Zanardini	GenBank	U33133	2

Hymenocladiopsis crustigena R.L. Moe	GenBank	AF085254	3
Irvinea ardreana (J. Brodie *et* Guiry) Guiry	GenBank	AF085274	3
Sebdenia flabellata (J. Agardh) P.G.Parkinson	GenBank	U33128	2
Webervanbossea splachnoides (Harv.) De Toni	GenBank	AF085269	3

[1] Reported as *Fauchea laciniata* in Saunders *et a*l., 1999.
[2] Reported as *Fauchea repens* in Saunders *et a*l., 1999.
1) Millar *et al*., 1996; 2) Saunders *et al*., 1996; 3) Saunders *et al*., 1999; 4) Saunders *et al*., 2007; 5) Rodriguez-Prieto *et* al., 2007.

Results

Gen. et. sp. nov. (Figs. 37-44)

The new genus possesses thalli that are to 7.0 mm in height. Plants arise from a basal holdfast above which the normally single small vesiculate branch expands rapidly above a short 1-2 mm hollow stipe, giving a peltate appearance (Fig. 37). Rarely two vesicles are produced from the same or two coalesced holdfasts. The inflated branches measure to 7 mm across. Thalli walls consist of three layers (Fig. 38); the medulla is composed of a single layer of larger rectangular cells, to 100 µm in length by 50-60 (-85) µm in height, with smaller triangular-shaped cells (to 30 µm in largest dimension) occasionally wedged between. Additional medullary cells are sometimes associated with fertile portions. The cortex consists of two layers, the innermost composed of rounded to tangentially elongate cells, 15-20 µm in diameter, and the outer continuous layer is mostly composed of spherical cells 3-4 µm in diameter. Secretory cells are mostly obpyriform (to 23 µm in length by 18 µm wide) and borne singly or in groups of 2-3 on medullary cells of normal position and size (Fig. 39) or from slightly smaller adventitiously produced cells (Fig. 40) that project into the vesicle cavity. Rudimentary medullary filaments are present at the very base of the plant and absent elsewhere (Fig. 41).

Plants are dioecious. Cystocarps protrude slightly (Fig. 42) and measure 270-320 µm in diameter. Spermatangial mother cells are cut off from outer cortical cells in a periclinal file of up to five spermatangial mother cells, to 8 µm in length (Fig. 43). Spermatangia are 2-5 µm in diameter and are cut off terminally from the spermatangial mother cells. Tetrasporangia are cut off from larger inner cortical cells in an intercalary position (Fig. 44) and possess a cruciate division pattern. Tetrasporangia are nearly spherical to slightly ovate, measuring to 22.5 µm in length and to 20 µm in width (Fig. 44). The new species is cryptic in habitat, growing largely hidden within crevices and difficult to access reef interstices.

A comparison of morphological and reproductive characters for the new genus, members included in the *Erythrocolon* group, as well as *Chrysymenia procumbens* Weber Bosse is presented in Table 11.

Collections: D.L.B.-6334, Turrumote Reef, La Parguera, 11 m, Coll. H.R., 5.x.2004; D.L.B.-6903 Turrumote Reef, La Parguera: 12 m, Coll. H.R., 21.xii,2005; D.L.B.-5707 Guanica, Edge of insular shelf, 20 m, Coll. H.R., 8.viii.2002; D.L.B.-6813 Turrumote Reef, La Parguera, 3 m, Coll. H.R., 11.ix,2005; D.L.B.-6343 Edge of insular shelf, offshore La Parguera, 14 m, Coll. H.R., 15.x.2004.

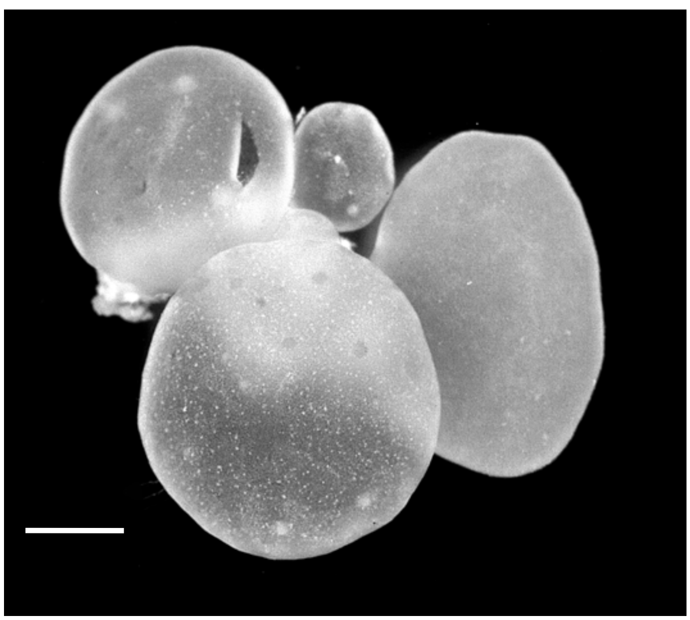

Fig. 37 Gen. nov. (D.L.B.-6334). Holotype showing vesiculate thalli (top view). Scale bar = 5 mm.

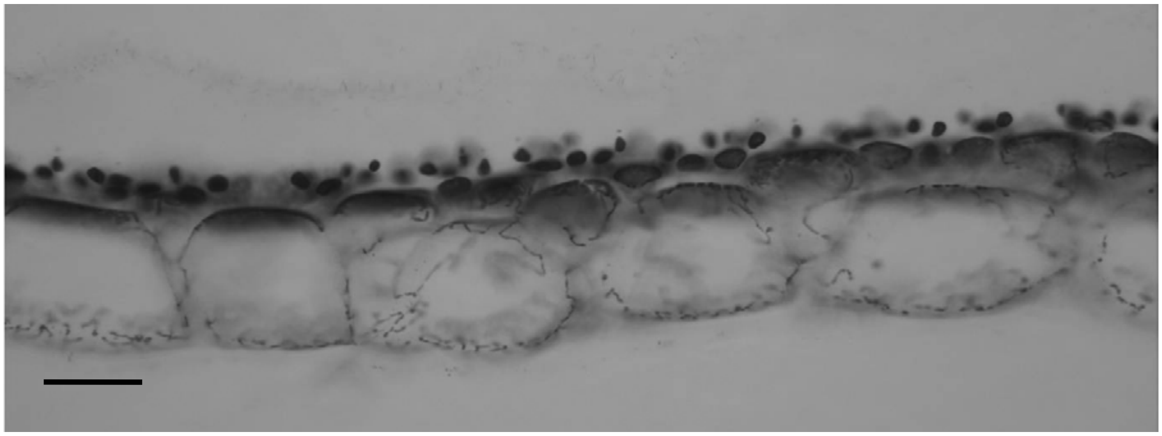

Fig. 38 Gen. nov. (D.L.B.-6903). Transection through vesicle wall showing single-celled medulla and two cortical layers. Scale bar = 50 µm.

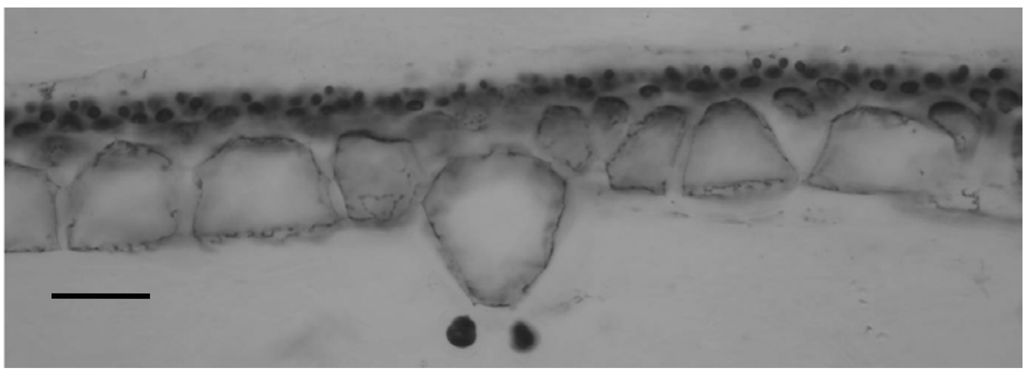

Fig. 39 Gen. nov. (D.L.B.-5707)**.** Transection through vesicle wall showing two gland cells produced from a medullary cell. Scale bar = 50 µm.

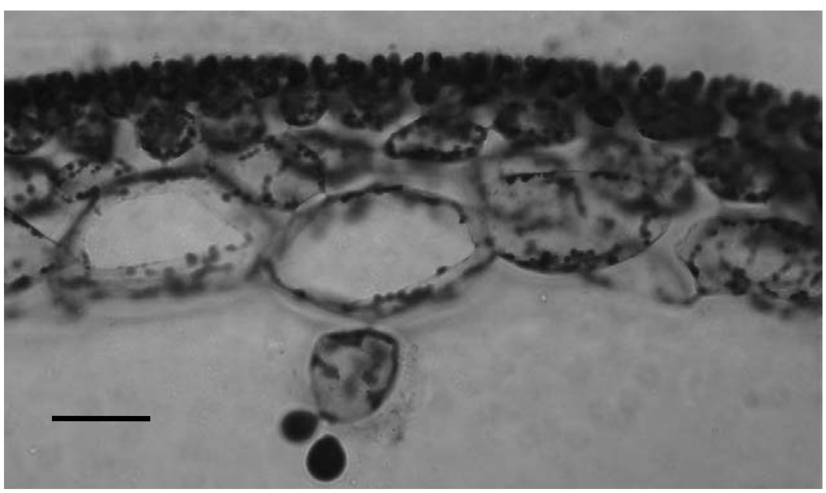

Fig. 40 Gen. nov. (D.L.B.-6903). Transection through vesicle wall showing two gland cells produced from a small secondary medullary cell. Scale bar = 50 µm.

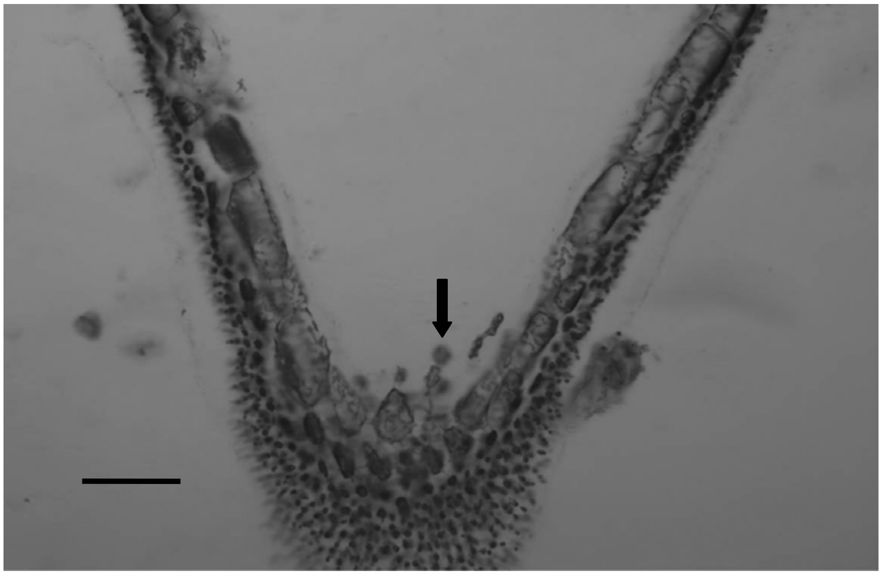

Fig. 41 Gen. nov. (D.L.B.-6813). Transection through vesicle wall and holdfast region showing rudimentary medullary filaments at base of the vesicle (arrow). Scale bar = 100 µm.

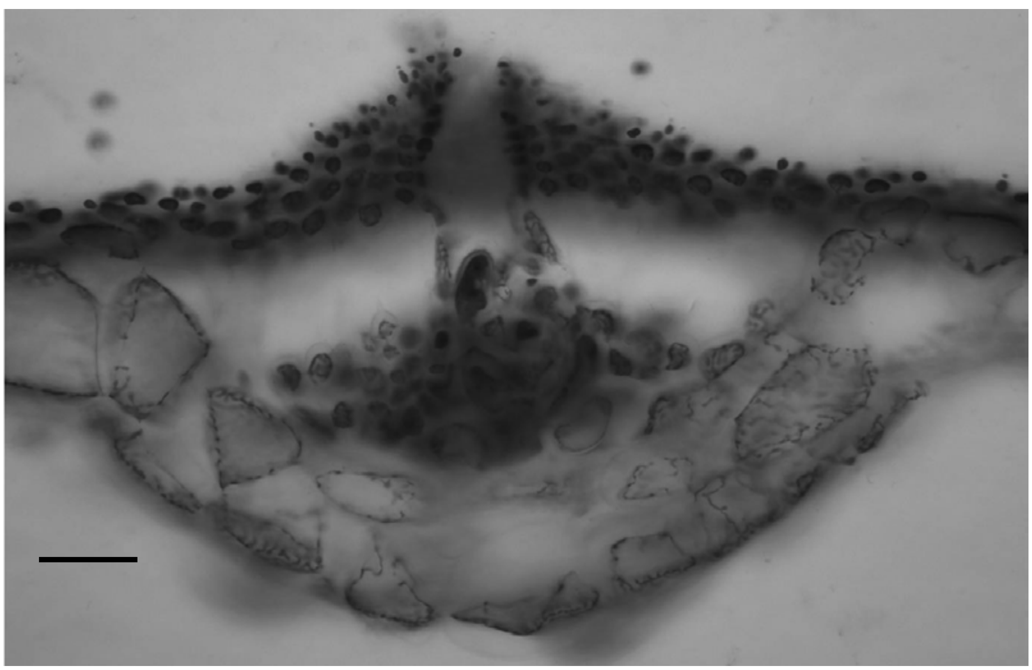

Fig. 42 Gen. nov. (D.L.B.-6343)**.** Transection through vesicle wall and cystocarps. Scale bar = 250 µm.

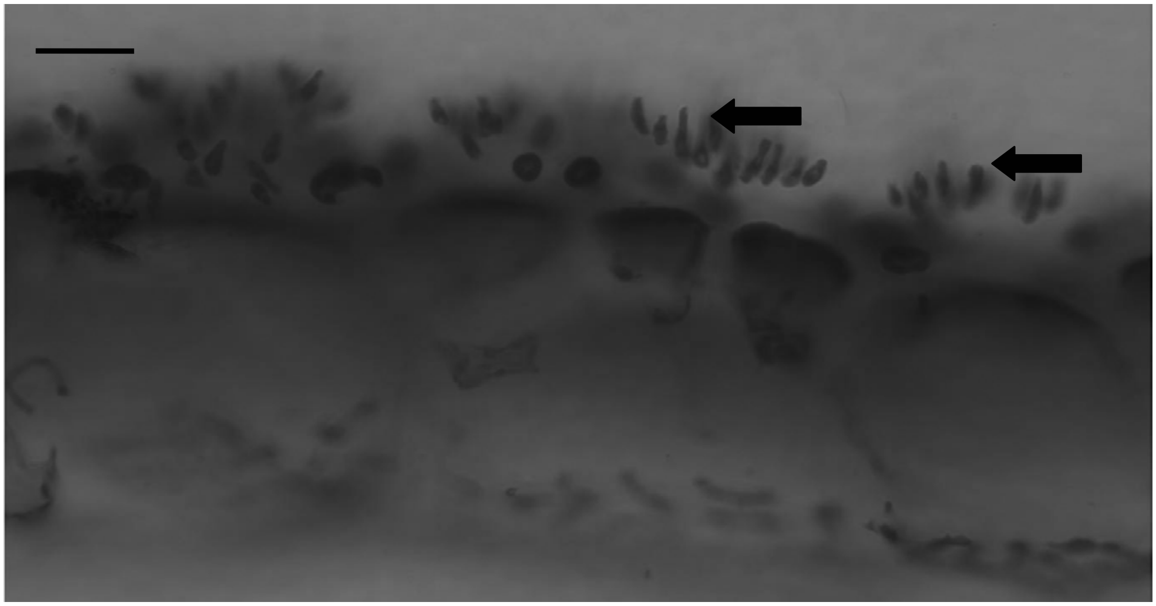

Fig. 43 Gen. nov. (D.L.B.-6343). Transection through vesicle wall showing radially elongate spermatangial mother cells (arrows) produced in periclinal series. Scale bar = 25 µm.

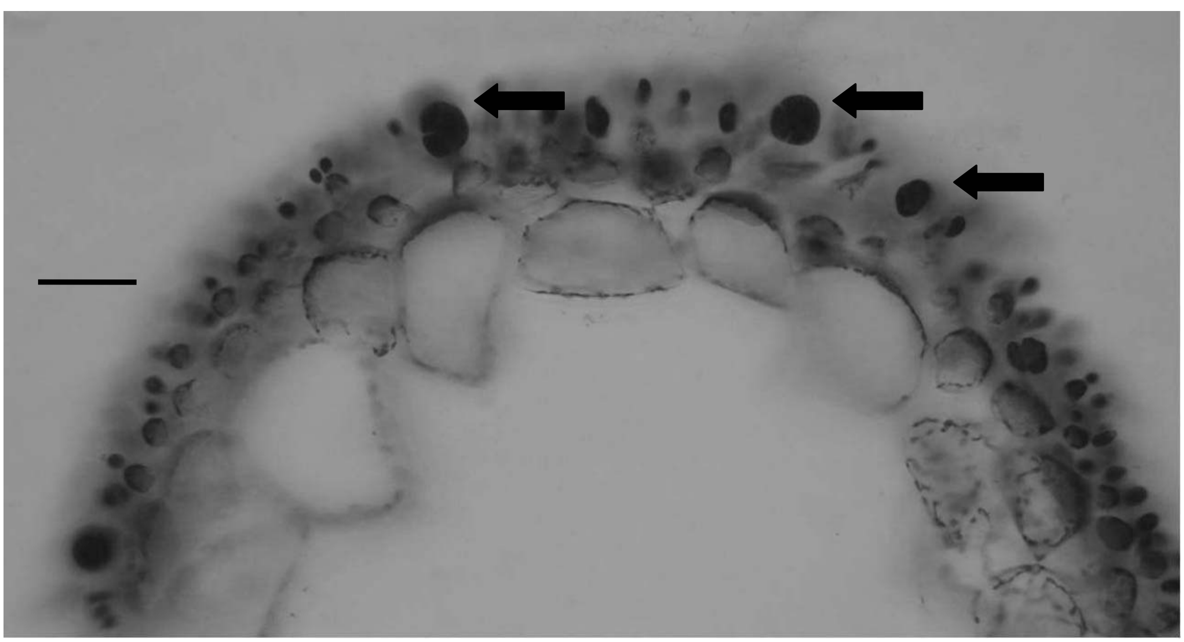

Fig. 44 Gen. nov. (D.L.B.-6903).Transection through vesicle wall showing tetrasporangia within the cortical layer (arrows). Scale bar = 25 µm.

Table 11. Comparison between the new genus, members of the *Erythrocolon* group and *Chrysymenia procumbens*.

Characters	New Genus	*Coelarthrum*	*Erythrocolon*	*Chamaebotrys*	*Chrysymenia procumbens*
Habit	Single small vesiculate thallus	Dichotomous or polychotomously branched; vesicle-like branches	Irregular to subdichotomously branched; vesicle-like branches	Spherical to ovoid segments, dichotomous to trichotomous or irregularly branched	Decumbent to prostrate, blade-like fronds with or without stipes
Stipe construction and size (height)	Hollow, 1-2 mm	Solid, not specified	Absent	Solid, Not specified	Not specified, 2-3 mm
Size (height)	7.0 mm	5-30 cm	3 cm	2-20 cm	1-2 cm
Septa	Absent	Regular	Irregular	Regular	Absent
Cortex	2 layers	2-3 layers	2 layers	1 layer	1 layer
Medulla	1 layer	3 to several layers	1 layer	1-2 layers	2-3 layers
Medullary filaments	Rudimentary at base	Absent in most species	Absent	Absent	Absent
Cystocarp	Protude slightly	Protuberant or partially immersed	Protuberant or partially immersed	Protuberant	Unknown
Cystocarp diameter	270-320 µm	700-1400 µm	700-800 µm	500 µm	Unknown
Tetrasporangial division and position	Cruciate, intercalary in cortex	Cruciate, intercalary in cortex	Cruciate, intercalary in cortex	Cruciate, terminal in nemathecia	Unknown

Table 13. cont.

Characters	New Genus	*Coelarthrum*	*Erythrocolon*	*Chamaebotrys*	*Chrysymenia procumbens*
Gametophtytes	Dioecious	Dioecious	Dioecious	Dioecious	Unknown
References	This study	Norris (1986); Huisman (1995)	Abbott and Littler (1969); Abbott (1999)	Huisman (1996); Schils *et al.* (2003)	Weber-van Bosse, (1928); Abbott (1999)

Molecular analysis

Thirty-six 18s sequences from various members of the *Chrysymenia*, *Botryocladia* and *Erythrocolon* groups and the Family Faucheaceae were included in the analysis to determine the phylogenetic position of the new genus. Seventeen new sequences of four *Botryocladia* spp., *Coelarthrum cliftonii*, *Chamaebotrys* sp., two *Chrysymenia* spp., and *Glioderma atlantica* Searles were included in the analysis. As indicated earlier, it was originally assumed that the new genus was a member of the genus *Chrysymenia*. Molecular analysis of 18s sequences provided evidence for species segregation and inclusion within the *Erythrocolon* group (Fig. 45). Sequence divergence between the new genus and other members of the *Erythrocolon* group varied from 1.1-1.4%. Divergence of 18s sequences between the new genus and *Chrysymenia* spp. was 2.3% and between the new genus and *Botryocladia* spp. was 2.1%. *Chamaebotrys* is shown to belong in the *Erythrocolon* group as well (Fig. 45). Results also indicate that *Gloiocladia atlantica* represents a sister taxon of *Gloioderma fruticulosum* (Harv.) De Toni.

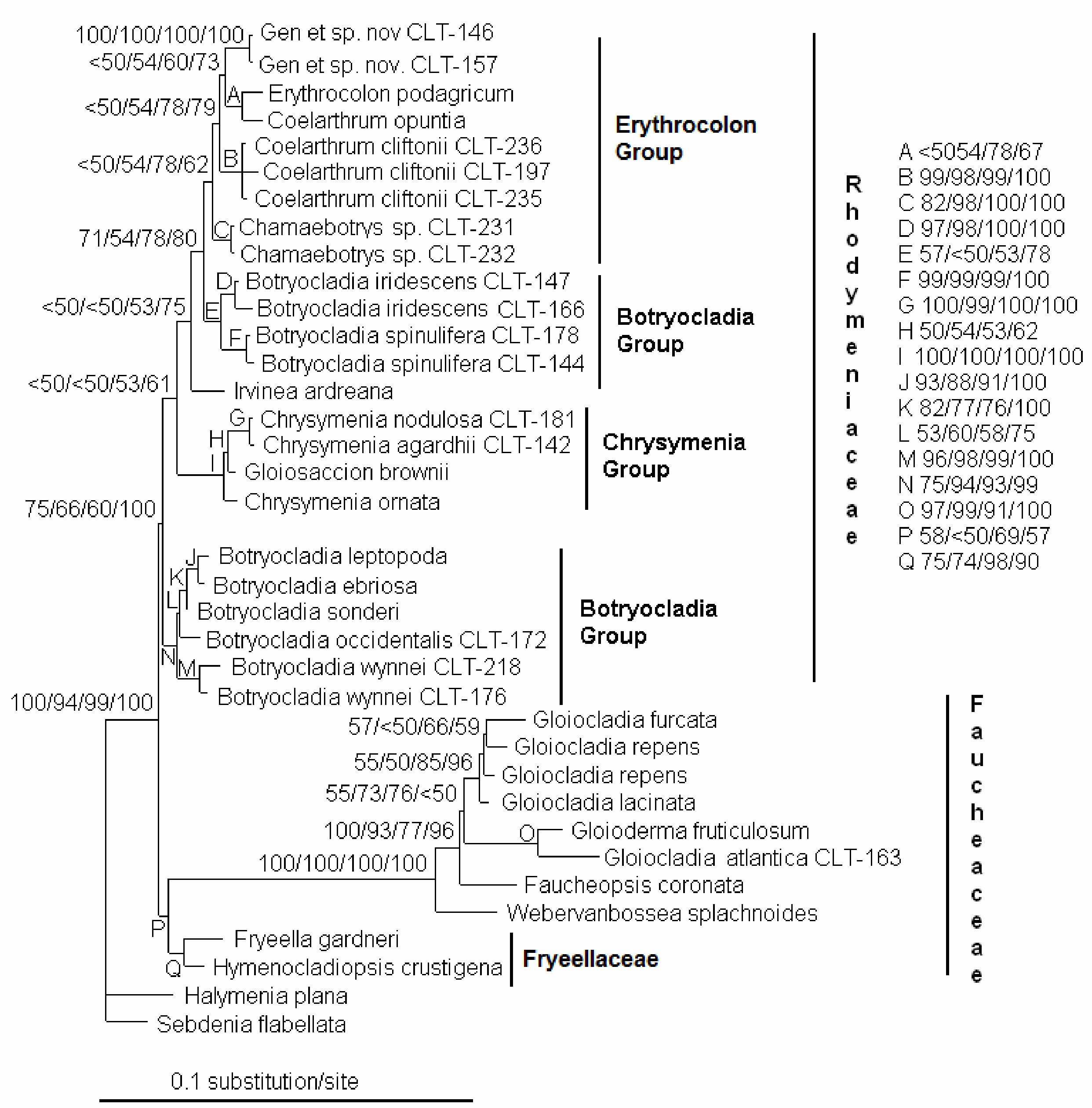

Fig. 45 Small ribosomal subunit (18s) phylogram obtained with Bayesian inference showing taxonomic position of the new genus within the Rhodymeniaceae. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Likelihood, 100 replicates; Maximum Parsimony, 2000 replicates; Neighbor Joining, 2000 replicates; Bayesian posterior probabilities,1,200,000 generations.

Discussion

On initial collection, we assumed that the new entity represented an undescribed species of *Chrysymenia*, sharing the characteristics of a non-septate, saccate thallus with cruciately divided tetrasporangia borne in an intercalary position. Aside from its reduced size and lack of thallus branching, there are no apparent morphological criteria to separate the new genus from *Chrysymenia* and the genera at present are only distinguishable on molecular bases. In addition, when observed in the field, the new genus is virtually indistinguishable from *Botryocladia iridescens*. Both species are small statured, restricted to cryptic reef habits, highly iridescent and may be differentiated on the basis of the latter possessing a solid stipe. Thus, the new genus, like *Irvinea* (Saunders *et al.*, 1999; Afonso-Carillo *et al.*, 2006; Schneider and Lane, 2008) becomes another rhodymeniacean genus without its own set of morphologically defining criteria. Nevertheless molecular data (Fig. 45) indicate a close relationship with the *Erythrocolon* group comprising *Coelarthrum* spp. and *Erythrocolon*. The new genus may be differentiated from all other *Erythrocolon* group genera by a combination of characters, principally including habit, lack of septation and presence of rudimentary filaments at the vesicle base (Table 11).

As previously indicated, the new entity is the only genus within the *Erythrocolon* group in which there is a lack of septation. Nevertheless, Gavio and Fredericq (2005, Fig. 53, p. 77) in their *rbc*L-based tree indicated that *Chrysymenia procumbens* Weber Bosse also claded with *Coelarthrum cliftonii* (without any bootstrap support) and that species was well separated from their clade which contained *Chrysymenia* (i.e. *C. halymenioides* Harv.). Gavio and Fredericq (2005) did not provide further discussion regarding the relationship between *Chrysymenia procumbens* and *Coelarthrum*. *Chrysymenia procumbens* may represent another undescribed, non-segmented genus of the *Erythrocolon* group or may even represent another species of the new genus. Unfortunately, we were unable to obtain *rbc*L sequence data for molecular comparison. *Chrysymenia procumbens* is a poorly known species, and it differs from the new genus by producing blade-like thalli rather than an inflated vesicle. We are reluctant to propose either a new genus or combination for *C. procumbens* without having reproductive material or *rbc*L sequence data in hand.

Our molecular data from the 18s gene also provided evidence that *Chamaebotrys* should be included within the *Erythrocolon* group in the Rhodymeniaceae (Fig. 45), despite the differences in tetrasporangial position (terminal in *Chamaebotrys* vs intercalary in the group). The genus *Chamaebotrys* was segregated from *Coelarthrum* by Huisman (1996) on the bases of habit and the formation of tetrasporangia in a terminal rather than in an intercalary position within nemathecia. Saunders *et al*. (1999) speculated on the familial placement of *Chamaebotrys*, and despite its apparent affinity with the Faucheaceae, he assigned the genus provisionally to the Rhodymeniaceae, considering that a reversion of the ancestral condition of terminal tetrasporangia had occurred in the genus. Morphological similarities of the genus *Chamaebotrys* and members of the *Erythrocolon* group include the possession of a hollow thallus with regular septations and cruciate tetrasporangia.

Several genera of Rhodymeniaceae have a conservative wall morphology, although species may vary in numbers of medullary and cortical layers, independently of genus (Huisman, 1996). Overlapping morphological and reproductive features among related Rhodymeniaceae genera have made generic recognition difficult. In fact Saunders *et al*. (1999) have discounted the importance of morphological features in delimiting even familial boundaries within the order. The erection of still another genus of Rhodymeniaceae with morphological and reproductive characters shared with other genera underscores the fact that features classically utilized to separate genera and species are frequently highly evolutionary conserved. Segmentation considered important in defining groups like the Champiaceae has been shown not necessarily to be consistent at the family level. For example, the assignment of *Coelothrix* to the Champiaceae was made despite lack of segmentation (Le Gall *et al*., 2008).

Norris (1991) transferred species of *Gloioderma*, including *G. atlantica* Searles and *G. fruticulosum* (Harv.) De Toni, to *Gloiocladia* in part on the basis of tetrasporangial disposition. Rodriguez-Prieto *et al*. (2007) on the basis of 18s sequence analysis, however, felt that the transfer of some *Gloioderma* species, including *G. fruticulosum*, was not warranted. Our 18s analysis (Fig. 45) indicates that *G. atlantica* represents a sister taxon of *Gloioderma fruticulosum.* Nevertheless no formal transfer can be suggested because there is no molecular data available for *Gloioderma australis* (J. Agardh) R.E. Norris (the type species of the genus), to relate the species to either genus.

Chapter 7: Further systematic observations based on Rhodymeniales molecular analyses

Summary – A molecular survey of Rhodymeniales, including species reported from Puerto Rico and DNA sequences available in GenBank, has provided further insights on phylogenetic relationships among genera within the order. Eighty-six 18s and sixty-six *rbc*L sequences were analyzed. All currently accepted families within the order are highly supported in a phylogram generated with the 18s gene sequences, including the recently proposed Hymenocladiaceae and Fryeellaceae. Sequence divergence in 18s sequences between *Gastroclonium ovatum*, *Chylocladia verticillata* and *C. schneideri* also suggests that *G. ovatum* represents another *Chylocladia* species. In addition, according to molecular evidence *Chrysymenia enteromorpha* and *C. wrightii* appear to be more closely related to the genus *Botryocladia* than to the other *Chrysymenia* species included in the analyses.

Introduction

The inclusion of molecular data in algal taxonomy, particularly in the red algae, has helped to resolve the taxonomic difficulties resulting from conservative morphological character expression, including thallus construction and cell wall morphology (Huisman, 1996). The first attempts to study red algal taxonomy using a molecular approach were by Ragan *et al*. (1994) and Freshwater *et al*. (1994). Subsequently this approach was applied to more specific taxonomic problems including species segregation and delimitation of genera with overlapping morphological characters (Millar *et al*., 1996; Saunders *et al*., 1999).

The order Rhodymeniales has undergone various taxonomic changes at the familial level as a result of the inclusion of nucleic acids as additional taxonomic characters (Saunders *et al*., 1999; Le Gall *et al*., 2008). The most common molecular markers used to address

Rhodymeniales taxonomic difficulties have been the 18s, *rbc*L and 28s genes (Saunders *et al*., 1999; Gavio and Fredericq, 2003, 2005; Le Gall *et al*., 2008). *Botryocladia*, *Champia*, *Maripelta* and *Leptofauchea* are examples of genera within the Rhodymeniales that have been studied using a combination of morphological characters and molecular data (Gavio and Fredericq, 2003, 2005; Saunders *et al*., 2007; Dalen and Saunders, 2007; Schneider and Lane, 2008; Ballantine and Lozada-Troche, 2008). Despite advances at the familial level and in certain genera within the order, there are still genera that as presently described represent heterogeneous assemblages (e.g. *Chrysymenia*) or do not possess a unique set of distinguishing characters (e.g. *Irvinea*, Gen. nov. discussed in Chapter 6). These factors result in taxonomic problems that can only be resolved by using an integrated approach combining morphology and molecular data from one or various genes. Results from a molecular survey of Rhodymeniales reported from Puerto Rico and sequences available on GeneBank are presented herein.

Materials and Methods

DNA sequences were obtained from GenBank and various Rhodymeniales species from Puerto Rico (Tables 12, 13). Total DNA extraction, 18s and *rbc*L gene amplification, and sequencing were performed as detailed in Chapter 3. The phylogenetic reconstruction was performed using the MP and NJ algorithms as implemented in PAUP* (v 4.1b10) (Swofford, 2002). Bayesian inference was generated with Mr.Bayes (v.3.1.2). The optimal model determined by Modeltest for 18s analysis was the GTR + I + G evolutionary model (General Time Reversal model + Invaiable sites + Gamma distribution) (Lanave *et al*., 1984; Rodríguez *et al*., 1990). The assumed nucleotide frequencies were: A = 0.2560, C = 0.2051, G = 0.2749, T = 0.2640. The assumed substitution rate matrix was: A-C = 0.9801, A-G = 3.2417, A-T = 1.3444

C-G = 0.6489, C-T = 3.9197, G-T = 1.0000. The proportion of sites assumed to be invariable = 0.5763; rates for variable sites were assumed to follow gamma distribution with shape parameter = 0.6392.

The optimal model for *rbc*L data was also GTR + I + G (Lanave *et al*., 1984, Rodríguez *et al*., 1990). The assumed nucleotide frequencies were: A= 0.3165, C= 0.1285, G= 0.1936, T= 0.3615. The assumed substitution rate matrix was: A-C substitutions = 1.3352, A-G= 6.9831, A-T= 2.0680, C-G= 1.9277 C-T= 14.9044, G-T=1.0000; proportion of sites assumed to be invariable= 0.4015; rates for variable sites were assumed to follow gamma distribution with shape parameter= 0.7993. The robustness of 18s and *rbc*L data was determined by bootstrapping the data set 1,000 times for MP and 2,000 for NJ (Felsenstein, 1985).

The optimal model for Bayesian inference for 18s sequences as determined by Moldeltest was the HKY + G model (Hasegawa, Kishino, and Yano + Gamma Distribution model) (Hasegawa *et al*., 1985). Bayesian analysis was performed running 4,000,000 generations and sampled every 100 generations with log-likelihood scores stabilized at approximately 11,000 generations. The first 12,000 of a possible 40,000 trees were discarded as burn-in. Bayesian analysis of *rbc*L sequences was determined using GTR + I + G evolutionary model and performed running 1,000,000 generations and sample every 100 generations with log-likelihood scores stabilizing at 5,000 generations. The first 5,500 of a possible 10,000 trees were discarded as burn-in.

Table 12 Species used in 18s gene sequence analysis.

Species	Source	Accesion Number	Reference
Asteromenia anastomosans G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft	GenBank	DQ343652	6
Asteromenia bermudensis G.W. Saunders, C.E. Lane, C.W. Schneider *et* Kraft	GenBank	DQ343651	6
Asteronemia peltata (W.R.Taylor) Huisman *et* A.Millar	GenBank	AY437710	6
Botryocladia ebriosa A. Millar	GenBank	AF085255	4
Botryocladia iridescens D.L. Ballant. *et* Ruiz (CLT-147)	La Parguera, PR	EF690265	This study
Botryocladia iridescens D.L. Ballant. *et* Ruiz (CLT-166)	La Parguera, PR	EF690266	This study
Botryocladia leptopoda (J.Agardh) Kylin	GenBank	DQ343160	8
Botryocladia occidentalis (Børgesen) Kylin (CLT-172)	Isabela, PR	EU086462	This study
Botryocladia sonderi P.C. Silva	GenBank	AF085256	4
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott (CLT-144)	La Parguera, PR	EU690268	This study
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott (CLT-178)	La Parguera, PR	EU670591	This study
Botryocladia wynnei D.L. Ballant. (CLT-176)	Lab culture	EF690267	This study
Botryocladia wynnei D.L. Ballant. (CLT-218)	La Parguera, PR	EU670589	This study
Cephalocystis furcellata (J.Agardh) A.Millar, G.W. Saunders, I.M.Strachan *et* Kraft	GenBank	U23953	2
Cephalocystis leucobotrys A.Millar, G.W. Saunders, I.M.Strachan *et* Kraft	GenBank	U23950	2
Ceratodictyon intricatum[1] (C. Agardh) R. E. Norris	GenBank	EF033594	7
Ceratodictyon spongiosum Zanardini	GenBank	AF117127	4
Ceratodictyon variabile[2] (J. Agardh) R. E. Norris	GenBank	AF085270	4
Chamaebotrys sp. (CLT-231)	San Juan, PR	EU715131	This study
Chamaebotrys sp. (CLT-231)	San Juan, PR	EU715132	This study
Champia affinis (Hook. *et*. Harv.) Harv.	GenBank	U23951	2
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212291	This study
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212292	This study
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF192576	9
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613311	9
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-194)	La Parguera, PR	FJ212289	This study
Champia cfr. *parvula* (CLT-173)	La Parguera, PR	EF190546	9
Champia cfr. *parvula* (CLT-198)	Culebra, PR	EF613310	9
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF192577	9
Champia salicornioides Harv. (DLB-6873)	Guanica, PR	EF192579	9
Champia vieillardii Kütz. (CLT-165)	La Parguera, PR	EF192580	9
Champia vieillardii Kütz. (CLT-221)	La Parguera, PR	FJ173067	This study

Champia vieillardii Kütz. (CLT-286)	La Parguera, PR	FJ212290	This study
Chylocladia schneideri D.L.Ballant. (CLT-127)	La Parguera, PR	EF192578	9
Chylocladia verticillata (Lightf.) Bliding	GenBank	AF085263	4
Coelarthrum cliftonii (Harv.) Kylin (CLT-197)	La Parguera, PR	EU086465	This study
Coelarthrum cliftonii (Harv.) Kylin (CLT-235)	La Parguera, PR	EU670594	This study
Coelarthrum cliftonii (Harv.) Kylin (CLT-236)	La Parguera, PR	EU670595	This study
Coelarthrum opuntia (Endl.) Børgesen	GenBank	AF085258	4
Coelothrix irregularis (Harv.) Børgesen (CLT-171)	La Parguera, PR	EU086456	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-202)	La Parguera, PR	EU086457	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-203)	La Parguera, PR	EU086458	This study
Cordylecladia erecta (Greville) J. Agardh	GenBank	U23952	2
Chrysymenia agardhii Harv. (CLT-142)	La Parguera,PR	EF690262	This study
Chrysymenia enteromorpha Harv. (CLT-143)	La Parguera, PR	EF690269	This study
Chrysymenia enteromorpha Harv. (CLT-201)	La Parguera, PR	EF690270	This study
Chrysymenia nodulosa J.N.Norris *et* D.L.Ballant. (CLT-181)	La Parguera, PR	EF690291	This study
Chrysymenia ornata (J.Agardh) Kylin	GenBank	AF085257	4
Chrysymenia wrightii (Harv.) Yamada	GenBank	AF117129	4
Chrysymenia wrightii (Harv.) Yamada	GenBank	EU916712	11
Dictyothamnion saltatum A. Millar	GenBank	AF085264	4
Drouetia coalescens (Farl.) De Toni	GenBank	DQ343653	6
Epymenia wilsonis Sonder	GenBank	U33128	3
Erythrocolon podagricum (Harv.) J. Agardh	GenBank	U23953	2
Erythrymenia minuta Kylin	GenBank	AF085272	4
Faucheopsis coronata (Harv.) Kylin	GenBank	AF085268	4
Fryeella gardneri (Setchell) Kylin	GenBank	AF085273	4
Gastroclonium ovatum (Huds.) Papenfuss	GenBank	AF085265	4
Gen. *et*. sp. nov.(CLT-146)	La Parguera, PR	EF690263	This study
Gen. *et*. sp. nov. (CLT-157)	La Parguera, PR	EF690264	This study
Gloiocladia furcata (C. Agardh) J. Agardh	GenBank	DQ790749	9
Gloiocladia laciniata[3] (J. Agardh) Sánchez *et* Rodríguez-Prieto	GenBank	AF085266	4
Gloiocladia repens (C. Agardh) Sánchez *et* Rodriguez-Prieto	GenBank	DQ790750	9
Gloiocladia repens[4] (C. Agardh) Sánchez *et* Rodriguez-Prieto	GenBank	AF085267	4
Gloioderma atlantica Searles (CLT-163)	La Parguera, PR	EU086461	This study
Gloioderma fruticulosum (Harv.) De Toni	GenBank	U33131	3
Gloiosaccion brownii Harv.	GenBank	AF085259	5
Halichrysis concrescens (J. Agardh) De Toni	GenBank	DQ343654	5

Halichrysis micans (Hauptfl.) P.Huvé *et* H.Huvé	GenBank	DQ343655	5
Halymenia plana Zanardini	GenBank	U33313	3
Hymenocladia chondricola (Sonder) J.Lewis	GenBank	AF117128	4
Hymenocladiopsis crustigena R.L. Moe	GenBank	AF085274	4
Irvinea ardreana (J. Brodie *et* Guiry) Guiry	GenBank	AF085254	4
Leptosomia rosea (Harv.) Womersley	GenBank	AF085260	4
Lomentaria australis (Kütz.) Levring	GenBank	L26194	1
Lomentaria baileyana (Harv.) Farl.	GenBank	U09621	1
Lomentaria rawitzcheri A.B. Joly (CLT-145)	La Parguera, PR	EU086460	This study
Lomentaria rawitscheri A.B. Joly (CLT-183)	La Parguera, PR	EU670592	This study
Maripelta rotata (E.Y.Dawson) E.Y. Dawson	GenBank	DQ343159	8
Rhodymenia divaricata E.Y. Dawson (CLT-240)	La Parguera, PR	EU670590	This study
Rhodymenia leptophylla J. Agardh	GenBank	AF085262	4
Rhodymenia stenoglossa J. Agardh	GenBank	AF085261	4
Sparlingia pertusa (Postels *et* Ruprecht) G.W. Saunders, I.M. Strachan *et* Kraft	GenBank	AF085261	4
Semnocarpa minuta Huisman, Foard *et* Kraft	GenBank	AF085271	4
Sebdenia flabellata (J. Agardh) P.G.Parkinson	GenBank	U33128	3
Webervanbossea splachnoides (Harv.) De Toni	GenBank	AF085269	4

[1] Reported as *Gelidiopsis intricata* in Le Gall and Saunders, 2007.
[2] Reported as *Gelidiopsis variabilis* in Saunders *et a*l., 1999.
[3] Reported as *Fauchea laciniata* in Saunders *et a*l., 1999.
[4] Reported as *Fauchea repens* in Saunders *et a*l., 1999.
1) Ragan *et al*., 1994; 2) Millar *et al*., 1996; 3) Saunders and Kraft, 1996; 4) Saunders *et al*., 1999; 5) Saunders *et al*., 2004; 6) Saunders *et al*., 2006; 7) Le Gall and Saunders, 2007; 8) Saunders *et al*., 2007; 9) Rodriguez-Prieto *et al*., 2007; 10) Ballantine and Lozada-Troche, 2008; 11) Barbara *et al*., 2008.

Table 13 Species used in *rbc*L gene sequence analysis.

Species	Source	Accesion Number	Reference
Botryocladia botryoides (Wulfen) J. Feldmann	GenBank	AY444169	7
Botryocladia canariensis Afonso-Carillo *et* Sobrino	GenBank	AY444172	8
Botryocladia caraibica Gavio *et* Fredericq	GenBank	AY168665	4
Botryocladia caraibica Gavio *et* Fredericq	GenBank	AY168666	4
Botryocladia ebriosa A. Millar	GenBank	AY444171	7
Botryocladia irridescens D.L. Ballant. *et* Ruiz (CLT-224)	La Parguera, PR	GQ146435	This study
Botryocladia madagascariensis G. Feldmann	GenBank	AY444168	8
Botryocladia monoica Schnetter	GenBank	AY168658	4
Botryocladia occidentalis (Børgesen) Kylin	GenBank	AY168660	4
Botryocladia occidentalis (Børgesen) Kylin (CLT-172)	La Parguera, PR	EU086463	This study
Botryocladia papenfussiana Ganesan *et* Lemus	GenBank	AY444173	8
Botryocladia pyriformis (Børgesen) Kylin	GenBank	AY168664	4
Botryocladia shanksii E.Y. Dawson	GenBank	AY168662	4
Botryocladia skottsbergii (Børgesen) Levring	GenBank	AY444175	8
Botryocladia spinulifera W.R.Taylor *et* I.A. Abbott	GenBank	AY444174	7
Botrycladia sp.	GenBank	AY444170	8
Botryocladia uvarioides E.Y. Dawson	GenBank	AY168663	4
Ceratodyction spongiosum Zanardini	GenBank	U21639	2
Ceratodyction sp.[1]	GenBank	AY294357	6
Champia compressa Harv.	GenBank	AY294358	6
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212295	This study
Champia sp. nov. (CLT-214)	La Parguera, PR	FJ212296	This study
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-177)	Guanica, PR	EF613316	9
Champia harveyana D.L.Ballant. *et* Lozada-Troche (DLB-6859)	La Parguera, PR	EF613317	9
Champia harveyana D.L.Ballant. *et* Lozada-Troche (CLT-194)	Guanica, PR	FJ179168	This study
Champia cfr. *parvula* (CLT-173)	La Parguera, PR	EU086464	9
Champia cfr. *parvula* (CLT-198)	Culebra, PR	EF613312	9
Champia salicornioides Harv. (DLB-6860)	La Parguera, PR	EF613314	9
Champia salicornioides Harv. (DLB-6873)	Guanica, PR	EF613315	9
Champia vieillardii Kütz. (CLT-221)	La Parguera, PR	EU670596	This study
Champia vieillardii Kütz. (CLT-286)	La Parguera, PR	FJ212299	This study
Chylocladia schneideri D.L.Ballant. (CLT-127)	La Parguera, PR	EF613313	9

Coelarthrum cliftonii (Harv.) Kylin (CLT-235)	La Parguera, PR	EU715136	This study
Coelothrix irregularis (Harv.) Kylin (CLT-171)	La Parguera, PR	EU086459	This study
Coelothrix irregularis (Harv.) Børgesen (CLT-215)	La Parguera, PR	EU670598	This study
Cordylecladia erecta (Greville) J. Agardh	GenBank	AY444178	7
Chrysymenia agardhii Harv. (CLT-142)	La Parguera, PR	EF690262	This study
Chrysymenia enteromorpha Harv. (CLT-143)	La Parguera, PR	GQ146433	This study
Chrysymenia enteromorpha Harv. (CLT-201)	La Parguera, PR	GQ146434	This study
Chrysymenia procumbens Weber Bosse	GenBank	AY294381	6
Chrysymenia wrightii (Harv.) Yamada	GenBank	EU916715	10
Chrysymenia wrightii (Harv.) Yamada	GenBank	EU916716	10
Epymenia capensis (J. Agardh) Papenfuss	GenBank	AF385646	5
Epymenia obtusa (Greville) Kützing	GenBank	AF385647	5
Epymenia wilsonis Sonder	GenBank	AF385650	5
Glioicladia laciniata[2] (J. Agardh) Sánchez *et* Rodríguez-Prieto	GenBank	AY294355	6
Halymenia floresii (Clemente *et* Rubio) C. Agardh	GenBank	AB038603	3
Halichrysis micans (Hauptfl.) P.Huvé *et* H.Huvé	GenBank	U21641	2
Irvinea ardreana (J. Brodie *et* Guiry) Guiry	GenBank	AY444177	7
Irvinea boergesenii (Feldmann) R.J. Wilkes, L.M. McIvor *et* Guiry	GenBank	AY444176	8
Lomentaria catenata Harv.	GenBank	U21642	4
Lomentaria hakodatensis Yendo	GenBank	AY294380	6
Lomentaria hakodatensis Yendo	GenBank	U04180	1
Maripelta rotata (E.Y.Dawson) E.Y. Dawson	GenBank	AY444179	7
Neogastroclonium subarticulatum[3] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	U04180	1
Neogastroclonium subarticulatum[4] (Turner) L. Le Gall, Dalen *et* G.W.Saunders	GenBank	AY294398	6
Rhodymenia corallina (Bory de Saint-Vincent) Greville	GenBank	AY168657	4
Rhodymenia divaricata E.Y. Dawson	La Parguera, PR	EU670597	This study
Rhodymenia intricata (Okamura) Okamura	GenBank	DQ787591	11
Rhodymenia pseudopalmata (J.V. Lamouroux) P.C. Silva	GenBank	AY168656	4
Rhodymenia skottsbergii E.Y. Dawson	GenBank	AY294354	5
Rhodymenia sp.	GenBank	AF385651	5

[1] Reporter as *Gelidiopsis* sp. in Gavio *et al*. (2005); [2]Reported as *Fauchea laciniata* in Gavio *et al*. (2005); [3] Reported as *Gastroclonium coulteri* in Freshwater *et al*. (1994); [4]Reported as *Gastroclonium subarticulatum* by Gavio *et al*. (2005).

1) Freshwater *et al*., 1994; 2) Fredericq *et al*., 1996; 3) Wang *et al*., 2000; 4 Gavio and Fredericq, 2003; 5) Hommensand and Fredericq, 2003; 6) Gavio *et al*., 2005; 7) Wilkes *et al*., 2005; 8) Wilkes *et al*., 2006; 9) Ballantine and Lozada-Troche, 2008; 10) Barbara *et al*., 2008, 11) unpublished data.

Results

A Bayesian tree was generated with eighty-six 18s sequences including representatives from all six currently accepted families. Thirty new 18s sequences from Rhodymeniales from Puerto Rico representing the families Rhodymeniaceae, Champiaceae, Lomentariaceae and Faucheaceae were also included in the analysis. All current families were highly supported by the 18s analyses (Fig. 46). The family Champiaceae had the highest 18s sequence divergence among genera (3.7%), while the Lomentariaceae had the lowest (1.53%); although the number of Champiaceae sampled (20) was substantially greater than the number of Lomentariaceae (8). Sequence divergence in 18s sequences among the currently accepted families varied between 2.38 and 9.32%. Sequence divergence in *rbc*L sequences within and among families was higher than those for 18s sequences, although the Hymenocladiaceae and Fryeellaceae were not included in the comparison. Sixty-six *rbc*L sequences representing the families Rhodymeniaceae, Champiaceae, Lomentariaceae and Faucheaceae were used to construct a phylogenetic tree. Fourteen new *rbc*L sequences from representatives of the Rhodymeniaceae and Champiaceae from Puerto Rico were added to the analysis. Results highly support all the families included in the analysis (Fig. 47).

The Bayesian phylogram inferred from 18s sequences indicated the polyphyletic nature of *Botryocladia* (Fig. 46). Two *Botryocladia* clades were resolved in the phylogenetic tree, one including *B. iridescens* D.L. Ballant. *et* Ruíz and *B. spinulifera* W.R.Taylor *et* I.A. Abbott and another comprising *B. ebriosa* A. Millar, *B. leptopoda* (J.Agardh) Kylin, *B. sonderi* P.C. Silva, *B. occidentalis* (Børgesen) Kylin and *B. wynnei* D.L.Ballant. Both clades are supported by moderate to high bootstrap and probability values. Sequence divergence between *Botryocladia* species varied between 0.8-2.1%. However, according to the *rbc*L analysis (Fig. 47) the recently described *B. iridescens* is phylogenetically close to the group that includes *B. madagascariensis* G.Feldmann, *B. botryoides* (Wulfen) J.Feldmann, *B. ebriosa* A.Millar, *B. spinulifera* W.R.Taylor *et* I.A.Abbott, *B. canariensis* Afonso-Carillo *et* Sobrino, *B. papenfussiana* Ganesan *et* Lemus, and *B. skottsbergii* (Børgesen) Levring. Differences in grouping of *B. iridescens* as compared to the 18s analysis are due to number of species included in the analysis and sequence length (Graybeal, 1998; Zwickl and Hillis, 2002), therefore *rbc*L analysis is more adequate for this genus and most molecular studies centered on the genus *Botryocladia* have used *rbc*L sequences (Gavio and Fredericq, 2003; Wilkes *et al*., 2006, Schneider and Lane, 2008).

The polyphyletic nature of the genus *Chrysymenia* is also evident in the 18s phylogram (Fig. 46), where two distinct clades can be identified. One clade includes *Chrysymenia enteromorpha* Harv. and *C. wrightii* (Harv.) Yamada and a second is comprised of *C. nodulosa* J.N.Norris *et* D.L.Ballant, *C. agardhii* Harv., *C. ornata* (J. Agardh) Kylin and *Gloiosaccion brownii* Harv. According to the 18s sequence phylogram, *Chrysymenia enteromorpha* and *C. wrightii* represent sister taxa forming a moderately supported clade (Fig. 46). This clade also represents a sister group of the genus *Botryocladia*. Analysis of *rbc*L sequences indicated similar results (Fig. 47), but sequence divergence was much higher (6.2-9.6%) than for 18s (1.06%).

Gloiosaccion brownii Harv. claded with *Chrysymenia nodulosa* J.N.Norris *et* D.L.Ballant., *C. agardhii Harv.* and *C. ornata* (J.Agardh) Kylin as seen in the 18s phylogram (Fig. 46). Sequence divergence between the former and the other *Chrysymenia* spp. varied from 0.41-0.65%, in accordance with values previously reported for Rhodymeniales species within a given genus (Saunders *et al*., 1999; Freshwater *et al*., 2005). In addition, divergence in 18s sequences between *Chylocladia verticillata* (Lightfoot) Bliding and *Gastroclonium ovatum*

(Hudson) Papenfuss (0.5%), suggests that they might be congeneric as well, suggesting that more research is needed to clarify their generic status.

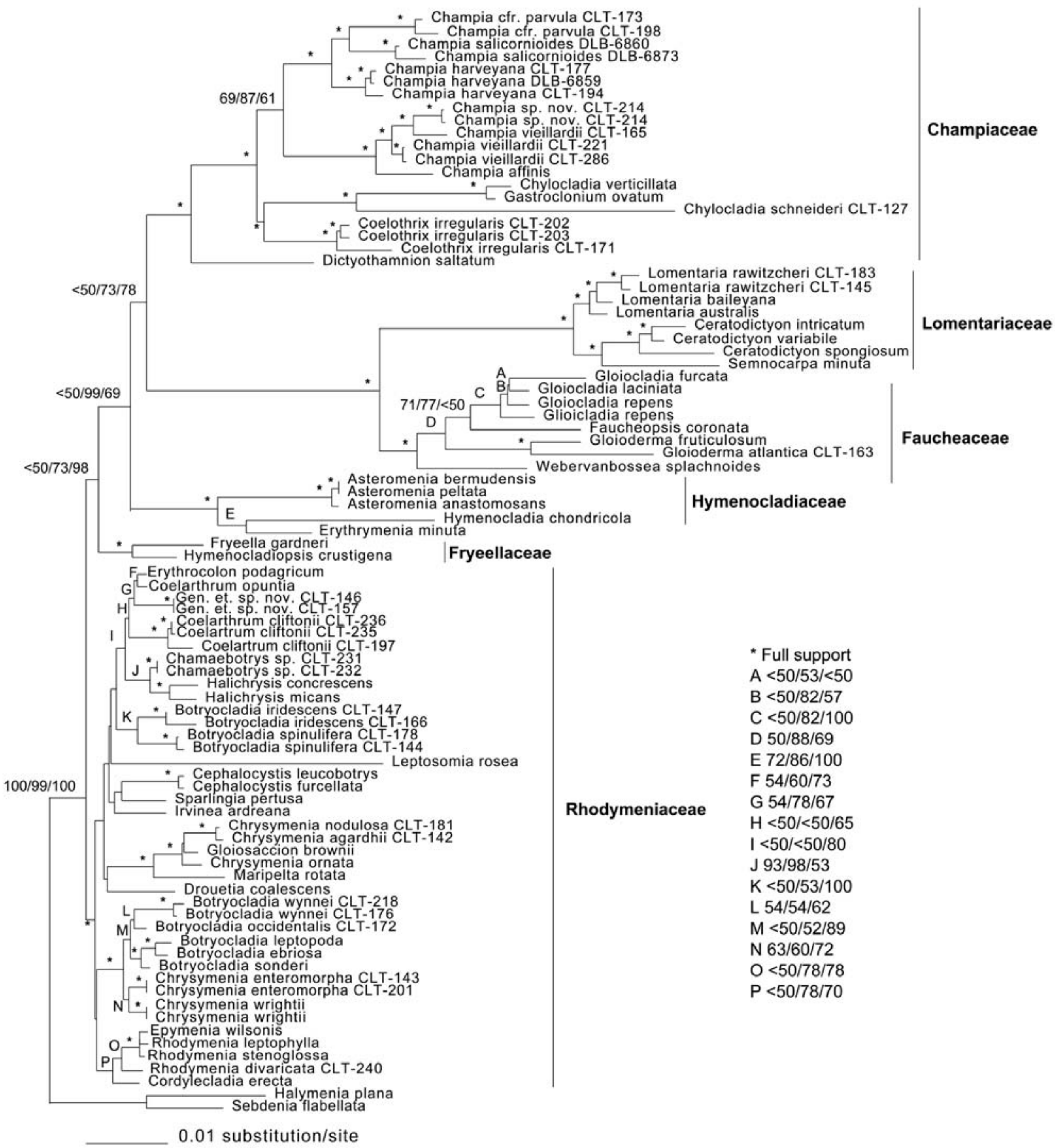

Fig. 46 Small ribosomal subunit (18s) sequence phylogram using Bayesian Analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Parsimony, 1000 replicates; Neighbor Joining, 2000 replicates; Bayesian posterior probabilities, 4,000,000 generations.

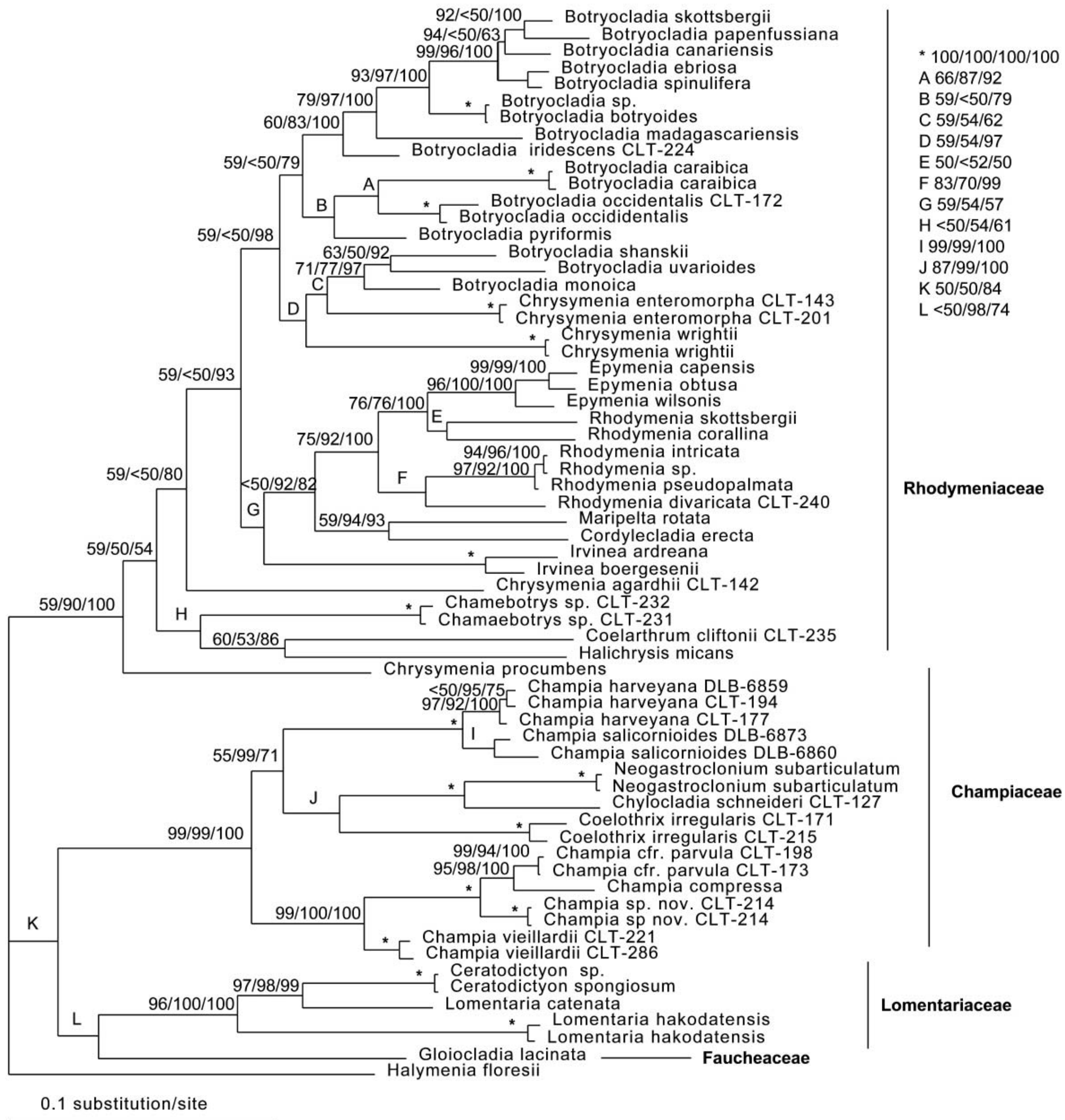

Fig. 47 Rubisco large subunit (*rbc*L) sequence phylogram inferred from Bayesian analysis. Bootstrap proportions are shown on top of the branches. Left to Right: Maximum Parsimony, 1000 replicates; Neighbor-Joining, 2000 replicates; Bayesian posterior probabilities, 1,000,000 generations.

Discussion

The genus *Chrysymenia* J. Agardh (1842) is characterized by terete or compressed hollow plants with few or no medullary filaments. In addition, tetrasporangia are cruciately divided and scattered over the thallus between cortical cells in intercalary position (Schneider and Searles, 1991; Wynne, 2005b). On the other hand the genus *Botryocladia* (J.Agardh) Kylin (1931) is characterized by plants with a terete solid axis which bear bladder-like spherical or obovoid brachlets with sympodial branching and also possess scattered cruciately divided tetrasporangia in intercalary position (Womersley, 1996; Afonso-Carillo and Sobrino, 2003; Afonso-Carillo *et al*., 2006). The morphological criteria to segregate these genera have received some attention with the recognition that these genera represent heterogenous assemblages (Saunders *et al*. 1999; Wilkes *et al*., 2006; Afonso-Carrillo *et al*., 2006). Recent molecular data from the *rbc*L gene provided further evidence of the polyphyletic nature of the genus *Chrysymenia* and the need for further examination (Gavio and Fredericq, 2005).

Chrysymenia enteromorpha was described by Harvey (1853) to define plants with bushy thalli, cylindrical branches without medullary filaments and scattered cruciately divided tetrasporangia. During early growth stages thallus appearance resembles that typical of the genus *Botryocladia* (Schneider and Searles, 1991, Fig. 399, p. 341). Our molecular analyses using 18s and *rbc*L further support the polyphyletic nature of the genus *Chrysymenia* and indicate the close phylogenetic relationship of *C. enteromorpha* and *C. wrightii* with the genus *Botryocladia*. Although these two species are very close, phylogenetically speaking, to the latter genus, 18s (1.05%) and *rbc*L (8.56%) sequence divergence between them suggests they should be maintained as distinct genera; however, they seem to be distantly related to the other

Chrysymenia species included in the analyses. In order to clearly define the generic identity of the genus *Chrysymenia* an extensive morphological and molecular-based study is needed.

The genus *Cryptarachne* was erected by Kylin (1931) to include compressed or flat *Chrysymenia* species with "internal filaments" in the medulla. Some authors considered *Cryptarachne* to be congeneric with *Chrysymenia* because some species of the latter also have internal, if reduced, medullary filaments (Okamura, 1936; Yamada and Segawa, 1953; Abbott and Littler, 1969). For example, both *Chrysymenia ventricosa* (Lamour.) J. Agardh, the species chosen by Kylin (1931) as the generitype for *Chrysymenia*, and *C. agardhii* Harv., selected by Kylin (1931) as the generitype for *Cryptarachne*, have internal filaments. Despite this ambiguous definition, Taylor (1960) and Ben Maïz *et al*. (1987) treated *Cryptarachne* as separate genera. Presently however *Cryptarachne* is considered to be congeneric with *Chrysymenia*. On the basis of the molecular analysis (18s and *rbc*L) herein, all *Chrysymenia* species previously known as *Cryptarachne* included in the analyses are resolved in a different clade than that including *Chrysymenia enteromorpha* and *C. writghtii* (Figs. 46, 47), suggesting the possibility of the validity of the latter genus. *Chrysymenia nodulosa* represents a sister taxa of *C. agardhii* (a former *Cryptarachne* species). Sequence divergence from 18s sequence suggests they are distict species within the same genus. On the other hand, *Gloiosaccion brownii* and *Chrysymenia ornata* are comprised in the same clade including *C. nodulosa* and *C. agardhii* (Fig. 46). Nevertheless, further study is required to delineate generic boundaries between *Cryptarachne* and *Chrysymenia*.

Harvey (1859) placed *Gloiosaccion* in the *Botryocladia* group as a monospecific genus. Later, the genus was considered a synonym of *Botryocladia* (Feldmann and Bodard, 1965). However, Womersley (1996) retained *Gloiosaccion* as a distinct genus on the basis of its habit, cortex construction, tetrasporangial arrangement and cystocarp protrusion. The 18s analysis (Fig. 46) showed that the genus *Gloiosaccion* is more closely related to the genus *Chrysymenia* than *Botryocladia,* as previously shown by Saunders *et al*. (1999), however no further remarks were made by them. Morphological similarities between *Gloiosaccion* and *Chrysymenia* include an unsegmented thallus, absence of "tela arachnoidea", and cruciately divided tetrasporangia in an intercalary position. Sequence divergence between *Gloiosaccion* and *Chrysymenia* species falls within the range known for Rhodymeniales species within a given genus (Saunders *et al*., 1999; Freshwater *et al*., 2005), suggesting that *Gloiosaccion brownii* might be another *Chrysymenia* species; nevertheless, major differences between the two genera are observed in cortex construction. Cortical cells in *Gloiosaccion* are formed in anticlinally oriented files, whereas in *Chrysymenia* they are not. The cystocarps in *Chrysymenia* are strongly protuberant while in G*loiosaccion* they are mostly immersed, barely protruding above the surface. Furthermore, in *Gloiosaccion* production of tetrasporangia occurs in nemathecia, which are absent in *Botryocladia* and *Chrysymenia* (Huisman, 1996). Despite the close phylogenetic relationship of the genus *Gloiosaccion* with *Chrysymenia* spp. shown by the molecular data, we choose to maintain the genera as separate until greater generic and species sampling has been completed.

The molecular results from 18s and *rbc*L genes provided evidence to include the genus *Chamaebotrys* in the Rhodymeniaceae as part of the *Erythrocolon* group (Figs. 46, 47). In the 18s analysis a highly supported clade included *Chamaebotrys* and *Halichrysis* (Fig. 46), while the *rbc*L phylogram indicated a close relationship between *Coelarthrum* and *Halichrysis*. Despite the differences in clading utilizing the different genes, it is evident that *Chamaebotrys* is closely related to both genera. As previously mentioned, differences observed in the tree topology are a result of differences in the number of species included in the analysis. The three genera possess protuberant cystocarps and cruciate tetrasporangial division, however in *Halichrysis* and *Chamaebotrys* tetrasporangial origin is terminal rather than intercalary.

Gastroclonium and *Chylocladia* are very similar in vegetative structure and reproduction and some think further studies may show that they are congeneric (Guiry and Guiry, 2008). Similarities between them include an erect thallus, dioecious gametophytes, non-ostiolate cystocarps and the absence of a "tela arachnoidea" (Ballantine, 2004). However, the fusion cells in *Chylocladia* expand rapidly and the gonimoblast cells transform quickly into carposporangia, giving the wrong impression of being cut off directly from the fusion cell (Ballantine, 2004). The main distinguishing character is the presence of a solid stalk in the former and its absence in the latter, and in addition to the occasional occurrence of polysporangia in *Gastroclonium*, including the type species, *G*. *ovatum.* Nevertheless, Stegenga *et al*. (1977) discounted the importance of polysporangia in distinguishing these genera. This close phylogenetic relationship is highly supported by molecular data (Fig. 46), suggesting that thallus construction may not be phylogenetically relevant to define these genera. Sequence divergence from 18s data (0.5%), which falls within the range for Rhodymeniales species within a given genus (Saunders *et al*., 1999; Freshwater *et al*., 2005), indicates that *G*. *ovatum* and *C*. *verticillata* might be congeneric. The close phylogenetic relationship between *Chylocladia verticillata* and *Gastroclonium* spp. is also mentioned by Le Gall *et al.* (2008), nevertheless no further discussion was provided regarding their congeneric taxonomic status. An extensive morphological and molecular study is needed to further clarify the generic identity of other specimens currently assigned to both genera.

The importance of morphological features in delimiting even familial boundaries within the order Rhodymeniales have been discounted by Saunders *et al*. (1999). Based on their molecular data they suggested that greater taxonomic value should be placed on reproductive features including carpogonial branch cell number and tetrasporangial position and cleavage pattern and, most recently, tetrasporangial origin (Le Gall *et al*., 2008). Despite the substantial increase in understanding of Rhodymeniales taxonomy, there is a number of genera whose taxonomic placement remains uncertain including, *Agardhinula*, *Binghamia*, *Binghamiopsis*, *Cenacrum*, and *Minium* among others. It is only by an integrated approach using reproductive characters and the inclusion of molecular data that Rhodymeniales taxonomy can be further clarified.

Conclusions

The recognition of new species, including cryptic species, demonstrates the need for molecular-based systematic studies to elucidate the complex taxonomy of the Rhodymeniales. Molecular-based studies have proven to be reliable tools to clarify taxonomic difficulties in genera with conservative vegetative morphology (e.g. *Botryocladia, Chrysymenia*). Taxonomic placement of various new genera as well as species with uncertain taxonomic affiliation (e.g. *Coelothrix irregularis*) has resulted from analyses of a combination of morphological and molecular information. The molecular evidence provided herein has shown that the genus *Chamaebotrys* belongs in the *Erythrocolon* group within the family Rhodymeniaceae. The recognition of a new genus was highly supported by molecular data and provided evidence for its inclusion in the *Erythrocolon* group as well, despite its vegetative morphological characters which suggested its placement as related to the genus *Chrysymenia*.

A new *Champia* species that superficially resembles *Champia parvula* was recognized. While it has been suggested that the actual geographic distribution of *Champia parvula* is limited to the eastern Atlantic, the species has been reported from a broad geographic distribution. Recognition of the new species brings into question the possibility of the existence of a complex of cryptic species. Molecular data analyses of specimens referred to *C. parvula* will be necessary to resolve the taxonomy.

Efforts to clarify the taxonomic placement of tropical Rhodymeniales from Puerto Rico have raised as many systematic questions as have been answered. For example polyphyly in common Caribbean genera including *Botryocladia* and *Chrysymenia* has been supported. Further molecular work including additional species will be required to provide a realistic phylogeny with monophyletic genera.

Recommendations

1. Conduct a detailed morphological and molecular study to established generic boundaries between the genera *Chrysymenia* and *Cryptarachne*.
2. Study the species currently classified in the genus *Gastroclonium* to determine their phylogenetic relationship with the genus *Chylocladia*.
3. Include the type species of the genus *Gloioderma*, *G.australis*, in a molecular survey to determine the relationship between *Gloioderma* and *Gloiocladia*.
4. Perform an extensive molecular biogeographic study to determine if the European *Champia parvula* is present in the Atlantic and the Caribbean.
5. Determine the taxonomic placement of *Agardhinula*, *Binghamia*, *Binghamiopsis*, *Cenacrum*, and *Minium* using molecular data as well as reproductive characters.
6. Establish the generic identity of *Gloiosaccion* and its phylogenetic relationship with the genus *Chrysymenia*.

Literature Cited

Abbott I.A. (1999). Marine Red Algae of the Hawaiian Islands. Bishop Museum Press, Honolulu. 477 p.

Abbott I.A., and M.M. Littler. (1969). New Rhodymeniales from Hawaii. Phycologia 8:165-169.

Afonso-Carrillo J., and C. Sobrino. (2003). Vegetative and reproductive morphology of *Botryocladia botryoides*, *B. occidentalis* and *B. canariensis* sp. nov. (Rhodymeniaceae, Rhodophyta) from the Canary Islands. Phycologia 42:138-150.

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

Agardh C.A. (1824). Systema algarum. pp. [i]-xxxviii, [1]-312. Lund: Berling.

Agardh J. (1842). Algae maris Mediterranei et Adriatici, observationes in diagnosin specierum et dispositionem generum. pp. X + 164. Paris: Fortin, Masson et Cie.

Agardh J.G. (1852). Species genera et ordines algarum, seu descriptiones succinctae specierum, generum et ordinum, quibus algarum regnum constituitur. Volumen secundum: algas florideas complectens. Part 2, fasc. 2. pp. 505-700, 701-720 [Addenda and Index]. Lundae [Lund]: C.W.K. Gleerup.

Akaike H. (1974). A new look at the statistical model identification. IEEE Transactions on Automatic Control 19:716–723.

Almodóvar L.R. and D.L. Ballantine. (1983). Checklist of benthic marine macroalgae plus additional species records from Puerto Rico. Caribbean Journal of Science 19:7-20.

Alongi G., M. Cormaci, and G. Furnari. (2008). *Chylocladia wynnei* sp. nov. (Champiaceae, Rhodophyta). Botanica Marina 51:145-150.

Aras S., A. Duran, and G. Yenilmez. (2003). Isolation of DNA for RAPD analysis from dry leaf material of some *Hesperis* L. specimens. Plant Molecular Biology Reporter 21:461a-461f.

Ardré, F. (1970). Contribution à l'étude des algues marines du Portugal. I. La flore. Portugalia Acta Biologica sér. B, 10: 137-555.

Bailey J.C. and D.W. Freshwater. (1997). Molecular systematics of the Gelidiales: inferences from separate and combined analyses of plastid *rbc*L and nuclear SSU gene sequences. European Journal of Phycology 32:343-352.

Ballantine D.L. (2004). *Chylocladia schneideri* sp. nov. (Champiaceae, Rhodophyta) from Puerto Rico, Caribbean Sea. Cryptogamie Algologie 25:125-132.

Ballantine D.L. (1985). *Botryocladia wynne* sp. nov. and *B. spinulifera* (Rhodymeniales, Rhodophyta) Taylor & Abbott from Puerto Rico. Phycologia 24:199-204.

Ballantine D.L. and N.E. Aponte. (2002a). *Botryocladia bahamense* sp. nov. (Rhodymeniaceae, Rhodophyta) from the Bahamas, western Atlantic. Cryptogamie Algologie 23:123-130.

Ballantine D.L. and N.E. Aponte. (2002b). A checklist of the benthic marine algae known to Puerto Rico. SecondRevision. http://ucjeps.berkeley.edu/constancea/83/ballantine_ aponte/checklist.html/

Ballantine D.L. and H.J. Humm. (1975). Benthic algae of the Anclote estuary I. Epiphytes on seagrass leaves. Quarterly Journal of the Florida Academy of Sciences 38:150-162.

Ballantine D.L. and C. Lozada-Troche. (2008). *Champia harveyana* (Champiaceae, Rhodophyta) from Puerto Rico, Caribbean Sea. Botanica Marina 51:388-398.

Ballantine D.L. and H. Ruíz. (2008). *Botryocladia iridescens* sp.nov. (Rhodymeniaceae, Rhodophyta) from Puerto Rico, Caribbean Sea. Cryptogamie Algologie 29:293-202.

Ballantine D.L., G.W. Saunders, and H. Ruíz. (2007). *Halichysis corallinarius* sp. nov. (Rhodymeniaceae, Rhodophyta) from Puerto Rico, Caribbean Sea. Phycological Research 55:240-248.

Barbara I., S.Y-Lee, V. Pena, P. Díaz, J. Cremades, J.H. Oak, and H.-G. Choi. (2008). C*hrysymenia wrightii* (Rhodymeniales, Rhodophyta) a new non-native species for the European Atlantic coast. Aquatic Invasions 3:379-387.

Ben Maïz N., C.-F. Boudouresque, R. Riouall, and M. Lautet (1987). Flore algale de l'etang de Thau (France, Méditerranée): Sur la présence d'une Rhodymeniale d'origine japonaise, *Chrysymenia wrightii* (Rhodophyta). Botanica Marina 30:357-364.

Bigelow R.P. (1888). On the structure of the frond in *Champia parvula*. Proceedings of the American Academy of Arts and Sciences 15 (part I), 111-121.

Bliding C. (1928). Studien über Die Florideenordnung Rhodymeniales. Lunds University Årssk. Ny Följd, Andra Avdelningen 2, 24(3):1-74.

Børgesen F. (1950). Some marine algae from Mauritius. Additions to the parts previously published. II. Kongelige Danske Videnskabernes Selskab, Biologiske Meddelelser 18(11):1-46.

Børgesen F. (1944). Some marine algae from Mauritius. III. Rhodophyceae. Part 3. Rhodymeniales. Kongelige Danske Videnskabernes Selskab, Biologiske Meddelelser 19(6): 1-32.

Børgesen F. 1920. The Marine Algae of the Danish West Indies. Part3. Rhodophyceae. Dansk Botanisk Arkiv 3:389-391.

Bula-Meyer G. (1997). Las especies de Champia (Rhodophyta: Champiaceae) de talo aplanado y una nueva del Caribe Colombiano. Caldasia 19: 83-90.

Bula-Meyer. G. (1985). *Champiocolax sarae* gen. *et*. sp. nov., an adelphohemiparasite of the Champiaceae (Rhodymeniales, Rhodophyta). Phycologia 24:429-435.

Britton N.L. (1918). Flora of Bermuda. Charles Scriber's Sons. New York. page 516

Britton N.L., and C.F. Millapaugh. (1920). The Bahama Flora. New York. page 113

Brodie J. and Guiry M.D. (1988). Life history and reproduction of *Botryocladia ardreana* sp. nov. (Rhodymeniales, Rhodophyta) from Portugal. Phycologia 27:109-130.

Brodie J. and Guiry M.D. (1988b). Life history and reproduction of *Cordylecladia erecta* (Rhodymeniaceae, Rhodophyta). British Journal of Phycology 23:347-364.

Brummitt R.K., and C.E. Powell (eds.). (1992). Authors of Plant Names. Kew, Royal Botanic Gardens, 732 p.

Chapman V.J. (1963). The Algae of Jamaica. Bulletin of the Institute of Jamaica Science Series No.12 Part 2. Phaeophyceae and Rhodophyceae. page 117-118.

Chase M.W., and H.H. Hills. (1991). Silica gel: an ideal material for field preservation of leaf samples for DNA studies. Taxon 40: 215-220.

Collins, F.S. (1901). The algae of Jamaica. Proceedings of the American Academy of Arts and Sciences 37: 229-270.

Collins F.S., and A.B. Hervey. (1917). The algae of Bermuda. Proceedings of the American Academy of Arts and Sciences 53: page 113

Dalen J.L., and G.W. Saunders. (2007). A review of the red algal genus *Leptofauchea* (Faucheaceae, Rhodymeniales) including a description of *L. chiloensis* sp. nov. Phycologia 46:198-213.

Davis B.M. (1896). Development of the cystocarp of *Champia parvula*. Botanical Gazette. 21: 109-17.

Davis B.M. (1892). Development of the frond of *Champia parvula,* Harv. from the carpospore. Annals of Botany. 24, 339-54.

Dawes C.J., and A.C. Mathieson. (2008). Seaweeds of Florida. University Press of Florida. 592 p.

Dawson, E. Y. (1954). Marine plants in the vicinity of the Institut Oce´anographique de Nha Trang, Viet Nam. Pacific Science 8: 373-481.

Díaz-Piferrer M. (1977). *Champia feldmannii*, a new species of Rhodophyta from Venezuela. Bulletin de la Société Phycologique de France 22: 40-46.

Díaz-Piferrer M. (1970). Adiciones a la Flora Marina de Venezuela. Caribbean Journal of Science 10: 159-198.

Felsenstein J. (1985). Confidence limits on phylogeny: an approach using the bootstrap. Evolution 39: 783-791

Feldmann G. (1967). Le genre *Cordylecladia* J.Ag. (Rhodophycées, Rhodyméniales) et sa position systématique. Revue Générale de Botanique 74: 357-375.

Feldmann G. and M. Bodard. (1965). Une novelle espèce de Botryocladia des côtes du Sénégal. Bulletin de l´Institut Océanographiqué [Monaco] 65 (1342):1-14.

Fredericq S., and M.H. Hommersand. (1989). Proposal of the Gracilariales ord. nov. (Rhodophyta) based on an analysis of the reproductive development of *Gracilaria verrucosa*. Journal of Phycology 25:213-227.

Fredericq S., M.H. Hommersand, and D.W. Freshwater. (1996). The molecular systematics of some agar-and carrageenan-containing marine red algae based on *rbc*L sequence analysis. Hydrobiologia 326/327: 125-135.

Fredericq S., D.W. Freshwater and M.H. Hommersand. (1999). Observations on the systematics of the Solieriaceae (Rhodophyta, Gigartinales) inferred from *rbc*L sequences and morphological evidence. Hydrobiologia 326/327:125-135.

Freshwater D.W. and J. Rueness. (1994). Phylogenetic relationships of some European *Gelidium* (Gelidiales, Rhodophyta) species, based on *rbc*L nucleotide sequences analysis. Phycologia 33:187-194.

Freshwater D.W., S. Fredericq, B.S. Butler, M.H. Hommersand, and M.W. Chase. (1994). A gene phylogeny of the red algae (Rhodophyta) based on plastid *rbc*L. Proceedings of the National Academy of Science 91:7281-7285.

Freshwater D.W., S. Katharine Braly, B. Stuercke, R.M. Hamner, and R.A. York. (2005). Phylogenetic analyses of North Carolina Rhodymeniales. I. The genus *Asteromenia*. Journal of the North Carolina Academy of Sciences 121:49-55.

Gabrielson P.W., and D.J. Garbary. (1987). A cladistic analysis of Rhodophyta: Florideophycean orders. British Phycological Journal 22:125-138.

Gabrielson P.W., and D.J. Garbary. (1986). Systematics of red algae (Rhodophyta). CRC Critical Reviews in Plant Sciences 3:325-366

Gargiulo G.M., G. Furnari, and M. Cormaci. (1991). Structure and reproduction of C*ordylecladia guiryi* sp. nov. (Rhodophyta, Rhodymeniales) from the Mediterranean Sea. Giornale Botanico Italiano 124: 631-640.

Gavio B., and Fredericq S. (2005). New species and new records of offshore members of the Rhodymeniales (Rhodophyta) in the Northern Gulf of Mexico. Gulf of Mexico Science 1:58-83.

Gavio B., and Fredericq S. (2003). *Botryocladia caraibica* (Rhodymeniales, Rhodophyta), a new species from the Caribbean. Cryptogamie Algologie 24:93-106.

Gavio B., E. Hickerson, and Fredericq S. (2005). *Platoma chrysymenioides* sp. nov. (Schizymeniaceae), and *Sebdenia integra* sp. nov. (Sebdeniaceae), two new red algal species from the Northeastern Gulf of Mexico, with a phylogenetic assessment of the Cryptonemiales complex (Rhodophyta). Gulf of Mexico Science 1:38-57.

Ginsburg-Ardré F. and M.F. Palminha. (1964). Extension de l'aire de repartition de *Coelothrix irregularis* (Harvey) Børgensen (Rhodophyceae, Champiaceae). Revue Algologique 7:325-331.

Graybeal A. (1998). Is It Better to Add Taxa or Characters to a Difficult Phylogenetic Problem? Systematic Biology 47:9- 17.

Greville R.K. (1930). Algae britaniccae, or descriptions of the marine and other inarticulated plants of the British Islands belonging to the order Algae, with plates illustrative of the genera. Maclachlan and Stewart, Edinburgh, Baldwin and Craddock, London

Guiry, M.D. (1990). Sporangia and spores. In: Biology of the Red Algae. (Cole, K.M. & Sheath, R.G. Eds), pp. 347-376. Cambridge: Cambridge University Press.

Guiry M.D. (1974). A preliminary consideration of the taxonomic position of *Palmaria palmata* (Linnaeus) Stackhouse = *Rhodymenia palmata* (Linnaeus) Greville. Journal of Marine Biology Association from the United Kingdom 54:509-528.

Guiry M.D., and Guiry, G.M. (2008). AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; searched on 04 February 2008.

Guiry M.D., and D.E.G. Irvine. (1981). A critical reassessment of infraordinal classification in the Rhodymeniales. Proceedings of the International Seaweed Symposium 8:106-111.

Gurgel C. F. D., and S. Fredericq. (2004). Systematics of the Gracilariaceae (Gracilariales, Rhodophyta): a critical assessment based on *rbc*L sequence analysis. Journal of Phycology 40:138-159.

Harper J.T., and Saunders G.W. (2001). The application of sequences of the ribosomal cistron to the systematics and classification of the florideophyte red algae (Florideophyceae, Rhodophyta). Cahiers de Biologie Marine 42:25-38.

Harvey W.H. (1859). *Phycologia Australica:* or, a history of Australian seaweeds; comprising coloured figures and descriptions of the more characteristic marine algae of New South Wales, Victoria, Tasmania, South Australia, and Western Australia, and a synopsis of all Known australian algae. Vol. 2. pp. [i]-viii, Plates LXI-CXX (with text). London: Lovell Reeve & Co.

Harvey W.H. (1853). Nereis boreali-americana; or, contributions towards a history of the marine algae of the atlantic and pacific coasts of North America. Part II. Rhodospermeae. Smithsonian Contributions to Knowledge 5(5): [i-ii], [1]-258, pls XIII-XXXVI.

Hasegawa, M., H. Kishino, and T. Yano. (1985). Dating the human-ape split by a molecular clock of mitochondrial DNA. Journal of Molecular Evolution 22: 160-174.

Hawkes M.W., and R.F. Scagel. (1986). The marine algae of British Columbia and northern Washington: division Rhodophyta (red algae), class Rhodophyceae, order Rhodymeniales. Canadian Journal of Botany 64:1549-1580.

Holmgren, P.K., H.H. Holmgren and L.C. Barnett. 1990. Index Herbariorum, Part I. The Herbaria of the World. New York Botanical Garden, Bronx, New York, x + 693 pp. [Regnum vegetabile vol. 120].

Hommersand M.H., and S. Fredericq. (2003). Biogeography of the marine red algae of the South African west coast: a molecular approach. Proceedings of the Seventeenth International Seaweed Symposium 17:325-336.

Huelsenbeck, J.P., and F. Ronquist. 2001. MRBAYES: Bayesian inference of phylogenetic trees. Bioinformatics 17:754-755.

Huisman, J.M. (2000). Marine Plants of Australia. pp. ix + 300. Nedlands, Western Australia: University of Western Australia Press.

Huisman J.M.(1996). The red algal genus *Coelarthrum* Børgesen (Rhodymeniaceae, Rhodymeniales) in Australian seas, including the description of *Chamaebotry*s gen. nov. Phycologia 35: 95-112.

Huisman J. M. (1995). The morphology and taxonomy of *Weberbanbossea* De Toni (Rhodymeniales, Rhodophyta). Cryprogamic Botany 5:367-374.

Huisman J.M., and A.J.K. Millar. (1996). *Asteromenia* (Rhodymeniaceae, Rhodymeniales), a new red algal genus based on *Fauchea peltata*. Journal of Phycology 32:138-145.

Hughey J.R., P.C. Silva, and M.H. Hommersand. (2001). Solving taxonomic and nomenclatural problems in Pacific Gigartinaceae (Rhodophyta) using DNA from type material. Journal of Phycology 37:1091-1109.

Huvé P., and H. Huvé (1977). Notes de nomenclature algale.1. Le genre *Halichrysis* (J. Agardh 1851 emend. J Agardh 1876) Stchousboe mscr. in Bonet 1892 (Rhodyméniales, Rhodyméniacées). Bulletin de la Societé Phycologique de France 22:99-107.

Irvine L.M., and Guiry M.D. (1983). Rhodymeniales. In: Seaweeds of the British Isles. Volume 1. Rhodophyta. Part 2A. Cryptonemiales (sensu stricto), Palmariales, Rhodymeniales. (Irvine, L.M. Eds), pp. 73-98. London: British Museum (Natural History).

Irvine D.E.G and M.D. Guiry. (1980). Taxonomy of Rhodymeniales. In: Taxonomy of Algae. (Desikachary T.V. and Raja Rao, V.N. Eds). pp. 287-303. International Symposium on Taxonomy of Algae, University of Madras.

Joly A.B., M. Cordeiro, N. Yanaguishi, and Y. Ugadim. (1965). Additions to the marine flora of Brazil IV. Rickia 2: 129-145.

Jones W.E. (1962). The identity of *Gracilaria erecta* (Grev.) Grev. British Phycological Bulletin 2:140-144.

Jones W.E. (1957). A note on the genus *Cordylecladia* J.Agardh (Algae: Rhodophyceae). Annuals and Magazine of Natural History Series 12,10:70-71.

Kraft G.T., and P.A. Robbins. (1985). Is the Order Cryptonemiales (Rhodophyta) defensible? Phycologia 24:67-77.

Kylin H. (1956). Die Gattungen der Rhodophyceen. Gleerups, Lund.

Kylin H. (1931). Die Florideenordnung Rhodymeniales. Lunds Universitets Årsskrift, Ny Följd, Andra Avdelningen 2,27:1-48.

Kylin H. (1930). Über die Entwicklungsgeschichte der Florideen. Acta Universitets Lunds. 26: 1-104.

Kylin H. (1928). Entwicklungsgeschichtliche Florideenstudien. Lunds Universitets Årsskrift, Ny Följd, Andra Avdelningen 2,24:1-127.

Lanave C., G. Preparata, C. Saccone and G. Serio. (1984). A new method for calculating evolutionary substitution rates. Journal of Molecular Evolution 20:86-93.

Lee I.K. (1978). Studies on Rhodymeniales from Hokkaido. Journal of the Faculty of Science, Hokkaido University, Series V (Botany) 11:1-194, pls I-V.

Le Gall L. and G.W. Saunders. (2007). A nuclear phylogeny of the Florideophyceae (Rhodophyta) inferred from combined EF2, small subunit and large subunit ribosomal DNA: Establishing the new red algal subclass Corallinophycidae. Molecular Phylogenetics and Evolution 43:1118-1130.

Le Gall L., J.L. Dalen, and G.W. Saunders. (2008). Phylogenetic analyses of the red algal order Rhodymeniales supports recognition of the Hymenocladiaceae fam. nov., Fryeellaceae fam nov., and *Neogastroclonium* gen. nov. Journal of Phycology 44:1556-1571.

Lin S-M., S. Fredericq, and M.H. Hommersand. (2001). Systematics of the Delesseriaceae (Ceramiales, Rhodophyta) based on large subunit rDNA and *rbc*L sequences, including the Phycodryoiceae, subfam. nov. Journal of Phycology 37:881-899.

Littler D.S. and M.M. Littler. (2000). Caribbean Reef Plants: An Identification Guide to the Reef Plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. Offshore Graphics, Inc., Washington, D.C. pp. 542.

Littler D.S., M.M. Littler, and M.D. Hanisak. (2008). Submersed Plants of the Indian River Lagoon: A Floristic Inventory and Field Guide. Offshore Graphics, Inc., Washington, D.C. pp. 286.

Maggs C.A., and C.M. Pueschel. (1989). Morphology and development of *Ahnfeltia plicata* (Rhodophyta): proposal of Ahnfeltiales ord. nov. Journal of Phycology 25: 333-351

Maggs CA., H. Verbruggen, and O. de Cleck. (2007). Molecular systematics of red algae: building future structure on firm foundations. In: Unravelling the algae: the past, present, and future of algal systematics (Ed. by J. Brodie and J. Lewis). Pp. 103-121. CRC Press, UK.

Masuda M., K. Kogame, S. Kawaguchi & S.M. Phang. (2001). Taxonomic Notes on Marine Algae from Malaysia. V. Five Species of Rhodymeniales (Rhodophyceae). Botanica Marina 44: 81-88.

Mazé H. and A. Schramm. 1888 (‘1870–1877’). Essai de classification des algues de la Guadeloupe. 2nd edition. Basse-Terre (Guadeloupe). pp. 283.

Millar A.J.K. (1998). *Champia womersleyi* (Champiaceae, Rhodophyta) a flattened and dichotomous new species from the South-Western Pacific. Botanica Marina 41: 15-21

Millar A.J.K. (1990). Marine Red Algae of the Coffs Harbour Region,Northern New South Wales. Australian Systematic Botany 3:293-593.

Millar A.J.K., G.W. Saunders, I.M. Strachan, and G.T.Kraft. (1996). The morphology, reproduction and small-subunit rRNA gene sequence of *Cephalocystis* (Rhodymeniaceae, Rhodophyta), a new genus based on *Cordylecladia furcellata* J. Agardh from Australia. Phycologia 35: 48-60.

Norris R.E. (1991). Some unusual marine red algae (Rhodophyta) from South Africa. Phycologia 30-582-596.

Norris R.E. (1987). The systematic position of *Gelidiopsis* and *Ceratodictyon* (Gigartinales, Rhodophyceae) genera new to South Africa. South Africa Journal of Botany 53:239-246.

Norris R.E. (1986). *Coelarthrum* (Rhodymeniaceae, Rhodophyceae), a new genus to southern Africa. South Africa Journal of Botany 52 :537-540.

Norris J.N., and D.L. Ballantine. (1995). Two new species of the red alga *Chrysymenia* J. Agardh (Rhodymeniales, Rhodophyta) from the tropical western Atlantic. Proceedings of the Biological Society of Washington 108:153-165.

Nott C.P. (1896). The antheridia of *Champia parvula*. Erythrea 4: 162-68.

Okamura K. (1936). Nippon Kaiso-shi. Author. Tokyo. (In Japanese), 964 p., 427 figs.

Oltmanns F. (1904). Morphologie and Biologie der Algen, vol1, Fishner, Jena, Germany.

Page R.D.M., and E.C. Holmes. (1998). Molecular Evolution: a phylogenetic approach. Blackwell Science, MA. 346 p.

Posada D., and K.A. Crandall. (2001). Selecting models of nucleotide substitution: An application to the human immunodeficiency virus 1 (HIV-1). Molecular Biology and Evolution 18(6): 897-906.

Posada D., and K.A. Crandall. (1998). Modeltest: testing the model of DNA substitution. Bioinformatics 14:817-818.

Price I.R. and G.T. Kraft. (1991). Reproductive development and classification of the red algas genus *Ceratodictyon* (Rhodymeniales, Rhodophyta). Phycologia 30:106-116.

Pueschel C. M., and K.M. Cole (1982). Rhodophycean pit plugs: an ultrastructural survey with taxonomic implications. American Journal of Botany 69:703-720.

Ragan M.A., C.J. Bird, E.L. Rice, R.R. Gutell, C.A. Murphy, and R.K. Singh. (1994). A molecular phylogeny of the marine red algae (Rhodophyta) based on the nuclear small-subunit rRNA gene. Proceedings of the National Academy of Science 91:7276-7280.

Reedman, D. J. and H.B.S. Womersley. (1976). Southern Australian species of *Champia* and *Chylocladia* (Rhodymeniales: Rhodophyta). Transactions of the Royal Society of South Australia 100: 75-104.

Rodriguez, R., J. L. Oliver, A. Marin and J. R. Medina. (1990). The general stochastic model of nucleotide substitution. Journal of Theoretical Biology 142:485-501.

Rodríguez-Prieto C., D.W. Freshwater, and N. Sánchez. (2007). Vegetative and reproductive morphology of *Gloiocladia repens* (C. Agardh) Sánchez et Rodríguez-Prieto comb. nov. (Rhodymeniales, Rhodophyta), with a taxonomic re-assessment of the genera *Fauchea* and *Gloiocladia*. European Journal of Phycology 42:145-162.

Sambrook J., Fritsch E.F., and Maniatis T. (1989). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor. N.Y. 6.2-6.19.

Saunders G.W. (2004). A chronicle of the convoluted systematics of the red algal orders Palmariales and Rhodymeniales (Florideophycydae, Rhodophyta). Cemar Occasional Notes in Phycology, published online. http://www.unb.ca/cemar/links/links/ Palmariales.pdf.

Saunders G.W. (1993). Gel purification of red algal genomic DNA: an inexpensive and rapid method for the isolation of polymerase chain reaction-friendly DNA. Journal of Phycology 29:251-254.

Saunders G.W., and M.H. Hommersand. (2004). Assesing red algal supraordinal diversity and taxonomy in the context of contemporary systematic data. American Journal of Botany 91:1494-1507.

Saunders G.W., and G.T. Kraft. (2002). Two new Australian (Nemastomataceae, Rhodophyta) with taxonomic recommendations for an emended species of *Predaea* Nemastomatales and expanded Halymeniales. Journal of Phycology 38:1245-1260.

Saunders G.W., and G.T. Kraft. (1997). A molecular perspective on red algal evolution: focus on the Florideophycidae. Plant Systematics and Evolution 11(suppl.):115-138.

Saunders G.W., and G.T. Kraft. (1996). Small-subunit rRNA gene sequences from representatives of selected families of the Gigartinales and Rhodymeniales (Rhodophyta). 2.Recognition of the Halymeniales ord. nov. Canadian Journal of Botany 74:694-707.

Saunders G.W., and G.T. Kraft. (1994). Small-subunit rRNA gene sequences from representatives of selected families of the Gigartinales and Rhodymeniales (Rhodophyta). 1.Evidence for the Plocamiales ord. nov. Canadian Journal of Botany 72:1250-1263.

Saunders G.W., I.M. Strachan, and G.T Kraft. (1999). The families of the order Rhodymeniales (Rhodophyta): a molecular-systematic investigation with a description of Faucheaceae fam. nov. Phycologia 38:23-40.

Saunders G.W., C.E. Lane, C.W. Schneider, and G.T Kraft. (2006). Unravelling the *Asteromenia peltata* complex with clarification of the genera *Halichrysis* and *Drouetia* (Rhodymeniaceae, Rhodophyta. Canadian Journal of Botany 84:1581-1607.

Saunders G.W., R.J. Wilkes, and M.D. Guiry. (2007). A nuclear small-subunit ribosomal DNA perspective on the taxonomic affinities of *Maripelta* (Rhodymeniales, Rhodophyta). Cryoptogamie Algologie 28:191-194.

Schils T., J.M. Huisman, and E. Coppejans. (2003). *Chamaebotrys erectus* sp. nov. (Rhodymeniales, Rhodophyta) from the Socotra Archipelago,Yemen. Botanica Marina 46:2-8.

Schmitz F. (1889). Systematische Übersicht der bisher bekannten Gattungen der Florideen. Flora 72:435-456, pl.21.

Schneider C.W. (1975). North Carolina marine algae. V. Additions to the flora of Onslow Bay, including reassignment of *Fauchea peltata* Taylor to *Webberella* Schmitz. British Phycological Journal 10:129-138.

Schneider C.W., and C.E. Lane. (2008). Notes on the marine algae of the Bermudas. 9. The genus *Botryocladia* (Rhodophyta, Rhodymeniaceae), including *B. bermudana*, *B. exquisita* and *B. flookii* spp. nov. Phycologia 47:614-629.

Schneider C.W., and R.B. Searles (1991). Seaweeds of the southeastern United States. Duke University Press, Durham NC. 553 p.

Schneider C.W., and M.J. Wynne (2007). A synoptic review of the classification of red algal genera a half century after Kylin's ''Die Gattungen der Rhodophyceen''. Botanica Marina 50-197-249.

Schwarz G. (1974). Estimating the dimension of a model. Annals of Statistics 6:461–464.

Silva P.C. (2002). Comments on the commentary of Kraft & Saunders [Phycologia 39:258-261 (2000)]. Phycologia 41:99-100.

Silva P.C. (1997–2004). Index Nominum Algarum. University Herbarium, University of California,Berkeley. Available online at http://ucjeps.berkeley.edu/INA.html; searched 2 December 2007.

Silva P.C., and H.W. Johansen. (1986). A reappraisal of the order Corallinales (Rhodophyceae). British Phycology Journal 21:245-254.

Silva P.C., P.W. Basson, and R.L. Moe. (1996). Catalogue of the benthic marine algae of the Indian Ocean. University of California Publications in Botany 79: 1-1259.

Sjostedt L. G. (1926). Floridean studies. Lunds Universitets Årsskrift, Ny Följd, Andra Avdelningen 2, 22(4):1-94.

Soto R. and D.L. Ballantine. (1986). La flora bentónica marina del caribe de Costa Rica (notas preliminaries). Brenesia 25-26:123-162.

Sparling S.R. (1957). The structure and reproduction of some members of the Rhodymeniaceae. University of California Publications in Botany 29:319-396.

Stegenga H., J.J. Bolton, and R.J. Anderson. (1977). Seaweeds of the South African West Coast. Contributions of the Bolus Herbarium No. 18, University of Cape Town. Creda Press. 655 pp.

Swofford D.L. (2002). PAUP*. Phylogenetic analysis using parsimony (* and other methods). Version 4.1. Sinauer Associates. Sunderland, MA, USA.

Taylor W.R., (1960). Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas. University Michigan Press, Ann Arbor. 870 pp.

Taylor W.R. (1942). Caribbean Marine algae of the Allan Hancock expedition, 1939. Report Allan Hancock Atlantic Expedition 2:113-114. pl.3, Fig.9; pl 16, Figs. 1-5.

Thompson J.D., T.J. Gibson, F. Plewniak, F. Jeanmougin, and D.G. Higgins. (1997). The Clustal_X windows interface: flexible strategies for multiple sequencing alignment aided by quality analysis tools. Nucleic Acid Research 25:4876-4882.

Vis M.L., G.W. Saunders, R.G. Sheath, K. Dunse, and T.J. Entwisle. (1998). Phylogeny of Batrachospermales (Rhodophyta), inferred from rbcL and 18S ribosomal DNA gene sequences. Journal of Phycology 34:341-350.

Wang H.W., S. Kawaguchi, T. Horiguchi, and M. Masuda. (2000). Reinstatement of *Grateloupia catenata* (Rhodophyta, Halymeniaceae) on the basis of morphology and *rbc*L sequences. Phycologia 39:228-237.

Weber Van-Bosse (1928). Liste des algues du Siboga, IV. Rhodophyceae: Gigartinales et Rhodymeniales. In: Weber M.(ed.) Siboga Expeditie, Monographie Vol. 59d, Leiden,E.J. Brill,pp. 393-533.

West J.A., and M.H. Hommersand. (1981). Rhodophyta: life histories. In: The Biology of Seaweeds (Ed. By C.S. Lobban & M.J. Wynne), pp. 743-750. Blackwell, Oxford.

Withall R.D., and G.W. Saunders. (2006). Combining small and large subunit ribosomal DNA genes to resolve relationships among orders of the Rhodymeniophycidae (Rhodophyta): recognition of the Acrosymphytales ord. nov. and Sebdeniales ord. nov. European Journal of Phycology 41:379-394.

White T.J., N.Arnheim, and H.A. Erlich. (1989). The polymerase chain reaction. Trends in genetics 5:185-189.

Wilkes R.J., L.M. Mcivor and, and M. Guiry. (2006). Vegetative morphology and rbcL phylogeny of some members of the genera *Botryocladia* and *Irvinea* (Rhodymeniaceae, Rhodophyta). Phycologia 45:481-494.

Wilkes R.J., L.M. Mcivor and, and M. Guiry. (2005). The taxonomic position of *Maripelta rotata* (Rhodymeniaceae, Rhodophyta). Cryptogamie Algologie 26:67-75.

Womersley H.B.S. (1996). The marine benthic flora of southern Australia, Rhodophyta. Part IIIB. Gracilariales, Rhodymeniales, Corallinales, and Bonnemaisoniales. Australian Biological Resources Study, Canberra. 392 pp.

Wynne M.J. (2005a). A checklist of benthic marine algae of the tropical and subtropical western Atlantic: second revision. Nova Hedwigia 129: 1-152.

Wynne M.J. (2005b). *Chrysymenia tigillum* sp. nov. (Rhodymeniales, Rhodophyta) from the Sultanate of Oman, with a census of currently recognized species in the genus *Chrysymenia*. Phycological Research 53: 215-223.

Wynne M.J. (1998). *Champia gigantea* and *Lomentaria strumosa* (Rhodymeniales): two new red algae from the Sultanate of Oman. Botanica Marina 41: 571-580

Wynne M.J., and G.T. Kraft.(1981). Classification summary. In: The Biology of Seaweeds (Ed. by C.S. Lobban and M.J. Wynne), pp. 743-750. Blackwell, Oxford.

Yamada Y. and S. Segawa (1953). On some new or noteworthy algae from Hachijo Island. Records of Oceanographic Works, Japan, N.S., 1:100-114.

Zwickl D.J., and D.M. Hillis. (2002). Increased Taxon Sampling Greatly Reduces Phylogenetic Error. Systematic Biology 5:588–598.

Appendix 1: Algae collection information

Species name	Collection Info	CLT coll. nos.	DLB coll. nos.
Botryocladia iridescens	Media Luna Reef, 12 m, Coll. H.Ruíz, 22.vii.2005	147	6568
Botryocladia iridescens	Shelf Edge, 20 m, Coll. H.R., 17.ii.2005	166	6463
Botryocladia irridescens	Shelf Edge, 15 m, Coll H.R.,12.xii.2006	224	7016
Botryocladia occidentalis	Punta Sardinera, Isabela, 12 m, Coll. H.R., 30.vii.2005	172	6592
Botryocladia spinulifera	Media Luna Reef, 12 m, Coll. H.R., 25.vii.2004	144	6286
Botryocladia spinulifera	Turrumote Reef, 10 m, Coll. H.R., 9.xi.2005	178	6828
Botryocladia wynnei	Lab. Culture	176	n/a
Botryocladia wynnei	Media Luna Algal Plain, 17 m, Coll. H.R. and D.L.B., 24.ix.2007	218	7202
Chamaebotrys sp.	San Juan Bay Pier 8, 2 m, Coll. H.R., 4.xi.2007	231	7257
Chamaebotrys sp.	San Juan Bay Pier 8, 2 m, Coll. H.R., 4.xi.2007	232	7257
Champia sp nov.	Cayo Caracoles, La Parguera, epiphytic on *Thalassia testudinum*, 1.5 m, Coll. C.L.T. and I.López, 6.ix.2007	214	n/a
Champia sp. nov	Cayo Caracoles, La Parguera, epiphytic on *Thalassia testudinum*, 1.5 m, Coll. C.L.T. and I.López, 6.ix.2007	214	n/a
Champia sp. nov.	Seaward Margarita Reef, 24 m, Coll. D.L.B., 3.viii.1985	2023	n/a
Champia sp. nov.	0.5 miles seaward Media Luna Reef, 16 m, Coll. DLB, 5.viii.1985	2091	n/a
Champia harveyana	Media Luna Reef Algal Plain, 12 m, Coll. H.R., 14.xii.2005	160	6859
Champia harveyana	Punta Brea Algal Plain, Guanica, 17 m, Coll. H.R.,15.ix.2005	177	n/a
Champia harveyana	Punta Brea Algal Plain, Guanica, 17 m, Coll. H.R., 15.ix.2005	194	n/a
Champia cfr. *parvula*	Media Luna Reef Algal Plain, 17 m, Coll. H.R., 7.vii.2005	173	6811
Champia cfr. *parvula*	Culebra Mangroves Roots, 2 m, Coll.H.R., 13.v.2006	198	n/a
Champia salicornioides	Media Luna Reef Algal Plain, 17 m, Coll. H.R.,14.xii.2005	161	6860
Champia salicornioides	Punta Brea Algal Plain, Guanica, 17 m, Coll. H.R., 15.ix.2005	195	6873
Champia vieillardii	Shelf Edge, 19 m, Coll. H.R., 17.ii.2005	165	6467
Champia vieillardii	Turrumote Reef, 10 m, Coll. H.R., 1.x.2007	221	n/a
Champia vieillardii	Shelf Egde (“Bouy”), 19 m, Coll. H.R., 24.vii.2008	286	7538
Chrysymenia enteromorpha	1.5 Km Seaward Media Luna Reef, 17 m, Coll. D.L.B., 24.ix.2004	143	6282
Chrysymenia enteromorpha	Margarita Reef, 24 m, Coll. H.R. and D.L.B., 7.vii.2006	201	6963
Chrysymenia nodulosa	Punta Brea, Guaniza, 17 m, Coll. C.L.T. and H.R., 6.iv.2006	181	n/a
Chrysymenia agardhii	1.5 Km Seaward Media Luna Reef, 17 m, D.L.B. and H.R., 22.xii.2003	142	6000
Chylocladia schneideri	Guayacan Island, La Parguera, epiphytic on *Halymeda incrassata*, 2 m, Coll. CLT and I.López, 26.iv.2005	127	n/a
Coelarthrum cliftonii	Punta Brea, Guanica, 17 m, Coll. H.R.15.xii.05	197	n/a

Coelarthrum cliftonii	Punta Brea, Guanica, 17 m, Coll H.R., 6.xi.2007	235	7260
Coelarthrum cliftonii	Punta Brea, Guanica, 17m, Coll. H Ruíz, 6.xi.2007	236	7260
Coelothrix irregularis	Media Luna Reef, 1 m, Coll. CLT and I.López, 22.iv.2005	171	n/a
Coelothrix irregularis	Media Luna Reef, 1 m Coll. CLT and I.López, 18.viii.2006	202	n/a
Coelothrix irregularis	Media Luna Reef, 1 m, Coll. CLT and I.López ,18.vii.2006	203	n/a
Coelothrix irregularis	Media Luna Reef, 1 m, Coll. CLT and I.López, 6.ix.2007	215	n/a
Coelothrix irregularis	Media Luna Reef, 1 m, Coll. CLT and I.López, 20.i.2009	287	n/a
Gloiocladia atlantica	Media Luna Reef, 12 m, Coll. H.R., 28.vii.2005	163	6467
Lomentaria rawitzcheri	Media Luna Reef, 6 m, Coll. H.R., 2.ix.2004	145	6305
Lomentaria rawitzcheri	Turrumote Reef, 6-8 m, Coll. H.R., 9.xi.2005	183	6820
New Genus	Turrumote Reef, 10 m, Coll. H R., 5.x.2004	146	6334
New Genus	Media Luna Reef, 12 m, Coll. H.R., 27.vii.04	157	6296
Rhodymenia divaricata	Shelf Edge, 50 m, Coll. H.R., 14.xi.2007	240	7305

Appendix 2: Alignment of small ribosomal subunit (18s) DNA sequences

Abbreviations and symbols used in the alignment (names are in the same order as they appear in the alignment)
Chy.verticillata = *Chylocladia verticillata*
Gastroclonium = *Gastroclonium ovatum*
Chy.schneideri = Chylocladia schneideri
C.irregularis202 = *Coelothrix irregularis*
C.irregularis203 = *Coelothrix irregularis*
Coelothrix171 = *Coelothrix irregularis*
C.harveyana177 = *Champia harveyana*
C.harveyana160 = *Champia harveyana*
Chharv194 = *Champia harveyana*
Ch.parvula173 = *Champia* cfr. *parvula*
C.parvula198 = *Champia* cfr. *parvula*
Ch.sali195 = *Champia salicornioides*
C.sali161 = *Champia salicornioides*
Champia214 = *Champia* sp. nov.
Champia214a = *Champia* sp. nov.
C.vieillardii = *Champia vieillardii*
Chviellar221 = *Champia vieillardii*
C.vieillardii286 = *Champia vieillardii*
Ch.affinis = *Champia affinis*
Dictyothamnion = *Dictyothamnion saltatum*
Hymenocladia = *Hymenocladia chondricola*
Erythrymenia = *Erythrymenia minuta*
Abermudensis = *Asteromenia bermudensis*
Apeltata = *Asteromenia peltata*
Asteranastomosans = *Asteromenia anastomosans*
Ch.nodulosa = *Chrysymenia nodulosa*
C.agardhii = *Chrysymenia agardhii*
Gloiosaccion = *Gloiosaccion brownii*
Chornata = *Chrysymenia ornata*
Maripelta = *Maripelta rotata*
Drouetia = *Drouetia coalescens*
Coelarthrum236 = *Coelarthrum cliftonii*
C.clifton235 = *Coelarthrum cliftonii*
C.cliftonii = *Coelarthrum cliftonii*
New genus
New genus
Erythrocolon = *Erythrocolon podagricum*
Coelaopuntia = *Coelarthrum opuntia*
Chamaebotrys231 = *Chamaebotrys* sp.
Chamaebotrys232 = *Chamaebotrys* sp.
Halichrysis = Halichrysis *concrescens*
Hmicans = *Halichrysis micans*

B.iridescens = *Botryocladia iridescens*
B.irri = *Botryocladia iridescens*
B.spinulifera = *Botryocladia spinulifera*
Bspinulifera144 = *Botryocladia spinulifera*
Leptosomia = *Leptosomia rosea*
Cephaleucobotrys = *Cephalocystis leucobotrys*
Cephafurcellata = *Cephalocystis furcellata*
Sparlingia = *Sparlingia pertusa*
Irvinea = *Irvinea ardreana*
Rhodymenia240 = *Rhodymenia divaricata*
Rhodymenia = *Rhodymenia stenoglossa*
Rhodyleptophylla = *Rhodymenia leptophylla*
Epymenia = *Epymenia wilsonis*
Cordylecladia = *Cordylecladia erecta*
Bwynnei218 = *Botryocladia wynnei*
B.wynnei = *Botryocladia wynnei*
Bleptopoda = *Botryocladia leptopoda*
Bebriosa = *Botryocladia ebriosa*
Bsonderi = *Botryocladia sonderi*
B.occidentalis = *Botryocladia occidentalis*
C.wrightii = *Chrysymenia wrightii*
C.wrightii = *Chrysymenia wrightii*
C.enteromorpha201 = *Chrysymenia enteromorpha*
C.enteromorpha143 = *Chrysymenia enteromorpha*
Halymenia = *Halymenia plana*
Sebdenia = *Sebdenia flabellata*
Fryeella = *Fryeella gardneri*
Hymenocladiopsis = *Hymenocladiopsis crustigena*
Lomentaria183 = *Lomentaria rawitzcheri*
Lomentaria145 = *Lomentaria rawitzcheri*
Lombaileyana = *Lomentaria baileyana*
Lomaustralis = *Lomentaria australis*
Ceraintricatu = *Ceratodictyon intricatum*
Ceratodict = *Ceratodictyon variabile*
Ceratodictyon = *Ceratodictyon spongiosum*
Semnocarpa = *Semnocarpa minuta*
Gloioderma = *Gloioderma fruticulosum*
Gloiocladi163 = *Gloiocladia atlantica*
G.furcata = *Gloiocladia furcata*
G.laciniata = *Gloiocladia laciniata*
Grepens = *Gloiocladia repens*
Gloirepens = *Gloiocladia repens*
Faucheopsis = *Faucheopsis coronata*
Webervanbossea = Webervanbossea *splachnoides*
*= conserved nucleotide
- = gap

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CLUSTAL 2.0.10 multiple sequence alignment


Chy.verticillata    CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
Gastroclonium       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Chy.schneideri      CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
C.irregularis202    CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
C.irregularis203    CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTTTCAAGGACTA
Coelothrix171       CACCTGGTTGATCCTGCCAGGTGGGTGATCG----CTGTCTCAAGGACTA
C.harveyana177      CACCTGGTTGATCCTGCCAGGTGGTATATGC----TGATGCTCAGGACTA
C.harveyana160      CACCTGGTTGATCCTGCCAGGTGGTATATGC----TGATGCTCAGGACTA
Chharv194           CACCTGGTTGATCCTGCCAGGTGGTATATGC----TGATGCTCAGGACTA
Ch.parvula173       CACCTGGTTGATCCTGCCAGGTGGTACCAAC----CATTGTTTAGGAATA
C.parvula198        CACCTGGTTGATCCTGCCAGGTGGTACCAAC----CATTGTTTAGGAATA
Ch.sali195          CACCTGGTTGATCCTGCCAGGTGGTATATGC----CTGTGCCTAGGACTA
C.sali161           CACCTGGTTGATCCTGCCAGGTGGTGTAAGC----CGGTGCCCAGGACTA
Champia214          CACCTGGTTGATCCTGCCAGGTGGATTATGC----TTGTCTTAAGGACTA
Champia214a         CACCTGGTTGATCCTGCCAGGTGGATTATGC----TTGTCTTAAGGACTA
C.vieillardii       CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
Chviellar221        CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
C.vieillardii286    CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
Ch.affinis          CACCTGGTTGATCCTGCCAGGTGGTATATGC----TTGTCTCAAGGACTA
Dictyothamnion      CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Hymenocladia        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Erythrymenia        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Abermudensis        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Apeltata            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Asteranastomosans   CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Ch.nodulosa         CACCTGGTTGATCCTGCCAG-TGGTATATTG----TTGGCTAAGGAACTA
C.agardhii          CACCTGGTTGATCCTGCCAG-TGGTATATTG----TTGGCTTAGGAACTA
Gloiosaccion        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Chornata            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Maripelta           CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Drouetia            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Coelarthrum236      CACCTGGTTGATCCTGCCAG-TGGTATATGCTTCATTGTCTCAAGGACTA
C.clifton235        CACCTGGTTGATCCTGCCAG-TGGTATATGCTTCATTGTCTCAAAGACTA
C.cliftonii         CACCTGGTTGATCCTGCCAG-TGGTATATGCCTCATTAGCTAGAGGACTA
New genus           CACCTGGTTGATCCTGCCAG-TGGTATATGCTTGGTTGGCCCAGGGATTA
New genus           CACCTGGTTGATCCTGCCAG-TGGTATATGCTTGGTTGGCCCAGGGATTA
Erythrocolon        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Coelaopuntia        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Chamaebotrys231     CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Chamaebotrys232     CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Halichrysis         CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Hmicans             CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
B.iridescens        CACCTGGTTGATCCTGCCAG-TGGTATAGGT----TTGTC-AAAGGATTA
B.irri              CACCTGGTTGATCCTGCCAG-TGGTATAGGT----TTGTCCAAAGGATTA
B.spinulifera       CACCTGGTTGATCCTGCCAG-TGGTATATGT----TTGTCCAAAGGATTA
Bspinulifera144     CACCTGGTTGATCCTGCCAG-TGGTATATGT----TTGTCCAAAGGATTA
Leptosomia          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Cephaleucobotrys    CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Cephafurcellata     CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Sparlingia          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Irvinea             CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
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Rhodymenia240       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Rhodymenia          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Rhodyleptophylla    CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Epymenia            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Cordylecladia       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Bwynnei218          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
B.wynnei            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Bleptopoda          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Bebriosa            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Bsonderi            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
B.occidentalis      CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGGCTCAAGGACTA
C.wrightii          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
C.wrightii          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
C.enteromorpha201   CACCTGGTTGATCCTGCCAG-TGGTATATGT----TTGTCTTAGGGACTA
C.enteromorpha143   CACCTGGTTGATCCTGCCAG-TGGTATATGT----TTGTCTTAGGGACTA
Halymenia           CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Sebdenia            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Fryeella            CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Hymenocladiopsis    CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Lomentaria183       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGCTTCCAGGACTA
Lomentaria145       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGCCTCAAGGACTA
Lombaileyana        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Lomaustralis        CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Ceraintricat        CACCTGGGTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Ceratodict          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Ceratodictyon       CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Semnocarpa          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Gloioderma          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Gloiocladi163       CACCTGGTTGGTTTTTCTGC-TTGTATATGC----TTGTCTCAAGAACTA
G.furcata           CACCTGGTTGGTTTTTCTGC-TTGTATATGC----TTGTCTCAAGGACTA
Glaciniata          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Grepens             CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Gloirepens          CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Faucheopsis         CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
Webervanbossea      CACCTGGTTGATCCTGCCAG-TGGTATATGC----TTGTCTCAAGGACTA
                    ******* ** *  * *    * *                    * **

Chy.verticillata    AGCCATGCAAGTCTAAGTATGAGTGATCCTATACAA-CGAAACTGCGAAT
Gastroclonium       AGCCATGCAAGTCTAAGTATGAGTGATCCTATACAA-CGAAACTGCGAAT
Chy.schneideri      AGCCATGCAAGGCTAAGTATAGGTGGTGCTATACAA-CAAAACTCAGAAT
C.irregularis202    AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.irregularis203    AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Coelothrix171       AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.harveyana177      AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.harveyana160      AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Chharv194           AGCCATGCAGGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Ch.parvula173       AGCCATGCAGGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.parvula198        AGCCATGCAGGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Ch.sali195          GCCCATGCAGGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.sali161           GCCCATGCAGGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Champia214          AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Champia214a         AGCCATGCAAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
C.vieillardii       AGCCATGCTAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Chviellar221        AGCCATGCTAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
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C.vieillardii286    AGCCATGCTAGTGTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Ch.affinis          AGCCATGCAAGTCTAAGTATGAGTGATATTATACAA-CGAAACTGCGAAT
Dictyothamnion      AGCCATGCAAGTGTAAGTATGAGTGTTCTTATACAA-CGAAACTGCGAAT
Hymenocladia        AGCCATGCAAGTGTAAGTATGAGAA-AATTATACAA-CGAAACTGCGAAT
Erythrymenia        AGCCATGCAAGTGTAAGTATGAGTA-A-TTATACAA-CGAAACTGCGAAT
Abermudensis        AGCCATGCAAGTGTAAGTATGAGTA-A-TTATACAA-CGAAACTGCGAAT
Apeltata            AGCCATGCAAGTGTAAGTATGAGTA-A-TTATACAA-CGAAACTGCGAAT
Asteranastomosans   AGCCATGCAAGTGTAAGTATGAGTA-A-TTATACAA-CGAAACTGCGAAT
Ch.nodulosa         AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.agardhii          GGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Gloiosaccion        AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Chornata            AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Maripelta           AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Drouetia            AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Coelarthrum236      AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.clifton235        AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.cliftonii         GGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
New genus           GGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
New genus           GGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Erythrocolon        AGCCATGCAAGTGTAAGTATGAGTG-AATTATACACACGAAACTGCGAAT
Coelaopuntia        AGCCATGCAAGTGTAAGTATGAGAG-AATTGTACAA-CGAAACTGCGAAT
Chamaebotrys231     AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Chamaebotrys232     AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Halichrysis         AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Hmicans             AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
B.iridescens        AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
B.irri              AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
B.spinulifera       AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Bspinulifera144     AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Leptosomia          AGCCATGCAAGTGTAAGTATGAGTC-TATTATACAA-CGAAACTGCGAAT
Cephaleucobotrys    AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Cephafurcellata     AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Sparlingia          AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Irvinea             AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Rhodymenia240       AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Rhodymenia          AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Rhodyleptophylla    AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Epymenia            AGCCATGCAAGTGTAAGTATGAGTG-CATTGTACAA-CGAAACTGCGAAT
Cordylecladia       AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Bwynnei218          AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
B.wynnei            AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Bleptopoda          AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Bebriosa            AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Bsonderi            AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
B.occidentalis      AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.wrightii          AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.wrightii          AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.enteromorpha201   AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
C.enteromorpha143   AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Halymenia           AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Sebdenia            AGCCATGCAAGTGTAAGTATGAGTG-AATTGTACAA-CGAAACTGCGAAT
Fryeella            AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Hymenocladiopsis    AGCCATGCAAGTGTAAGTATGAGTG-AATTATACAA-CGAAACTGCGAAT
Lomentaria183       AGCCATGCAAGTGTAAGTATGAGGAATATTATACAA-CGAAACTGCGAAT
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Lomentaria145       AGCCATGCAAGTGTAAGTATGAGGAATATTATACAA-CGAAACTGCGAAT
Lombaileyana        AGCCATGCAAGTGTAAGTATGAGGAATATTATACAA-CGAAACTGCGAAT
Lomaustralis        AGCCATGCAAGTGTAAGTATGAGGAATATTATACAA-CGAAACTGCGAAT
Ceraintricat        AGCCATGCAAGTGTAAGTATGAGGAAGATTATACAA-CGAAACTGCGAAT
Ceratodict          AGCCATGCAAGTGTAAGTATGAGGAAGATTATACAA-CGAAACTGCGAAT
Ceratodictyon       AGCCATGCAAGTGTAAGTATGAGGAAGATTATACAA-CGAAACTGCGAAT
Semnocarpa          AGCCATGCAAGTGTAAGTATGAGGAATATTATACAA-CGAAACTGCGAAT
Gloioderma          AGCCATGCAAGTGTAAGTATGAGTG-AGTTGTACAA-CGAAACTGCGAAT
Gloiocladi163       GGCCATGCAAGTGTAAGTATGAGTA-TGTTGTACAA-CGAAACTGCGAAT
G.furcata           AGCCATGCAAGTGTAAGTATGAGTG-TGTTATACAA-CGAAACTGCGAAT
Glaciniata          AGCCATGCAAGTGTAAGTATGAGTG-TGTTATACAA-CGAAACTGCGAAT
Grepens             AGCCATGCAAGTGTAAGTATGAGTG-TCTTATACAA-CGAAACTGCGAAT
Gloirepens          AGCCATGCAAGTGTAAGTATGAGTG-TGTTATACAA-CGAAACTGCGAAT
Faucheopsis         AGCCATGCAAGTGTAAGTATGAGTG-TCTTATACAA-CGAAACTGCGAAT
Webervanbossea      AGCCATGCAAGTGTAAGTATGAGTG-TCTTATACAA-CGAAACTGCGAAT
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Chy.verticillata    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT—ACTACTTGGATA
Gastroclonium       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTTGGATA
Chy.schneideri      GGCTCCGTAAAACAGCTATAGTTTCTTCGATGGTAT--ACTACTTGGATA
C.irregularis202    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.irregularis203    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Coelothrix171       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.harveyana177      GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.harveyana160      GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Chharv194           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Ch.parvula173       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.parvula198        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Ch.sali195          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.sali161           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Champia214          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Champia214a         GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.vieillardii       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Chviellar221        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
C.vieillardii286    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Ch.affinis          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Dictyothamnion      GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAT--ACTACTCGGATA
Hymenocladia        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATAA---CTACTCGGATA
Erythrymenia        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATTTT--CTACTCGGATA
Abermudensis        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATTTT--CTACTCGGATA
Apeltata            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATTTT--CTACTCGGATA
Asteranastomosans   GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATTTT--CTACTCGGATA
Ch.nodulosa         GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
C.agardhii          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Gloiosaccion        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Chornata            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Maripelta           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Drouetia            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Coelarthrum236      GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.clifton235        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.cliftonii         GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
New genus           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
New genus           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Erythrocolon        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
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Coelaopuntia        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Chamaebotrys231     GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Chamaebotrys232     GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Halichrysis         GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Hmicans             GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
B.iridescens        GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
B.irri              GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
B.spinulifera       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Bspinulifera144     GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Leptosomia          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Cephaleucobotrys    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Cephafurcellata     GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Sparlingia          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Irvinea             GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Rhodymenia240       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Rhodymenia          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Rhodyleptophylla    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Epymenia            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Cordylecladia       GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Bwynnei218          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
B.wynnei            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Bleptopoda          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Bebriosa            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Bsonderi            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
B.occidentalis      GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.wrightii          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.wrightii          GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.enteromorpha201   GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
C.enteromorpha143   GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Halymenia           GGCTCGGTAAAACAGCTATAGTTTCTTCGATGGTAAA--CTACTCGGATA
Sebdenia            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATG--CTACTCGGATA
Fryeella            GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Hymenocladiopsis    GGCTCGGTAAAACAGCTATAGTTTCTTCGATGATATA--CTACTCGGATA
Lomentaria183       GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATT-ACTTTACGGATA
Lomentaria145       GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATT-ACTTTACGGATA
Lombaileyana        GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATT-ACTTTACGGATA
Lomaustralis        GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATT-ACTTCACGGATA
Ceraintricat        GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTAAT-ACTTTACGGATA
Ceratodict          GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATTTACTTTACGGATA
Ceratodictyon       GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATTTACTTTACGGATA
Semnocarpa          GGCTCGGTAAAACAGCAATAATTTCTTCGATGCTATTTA-TTTACGGATA
Gloioderma          GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-TCTACTCGGATA
Gloiocladi163       GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-TCTACTCGGATA
G.furcata           GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-ACTACTCGGATA
Glaciniata          GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-ACTACTCGGATA
Grepens             GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-ACTACTCGGATA
Gloirepens          GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTCAT-ACTACTCGGATA
Faucheopsis         GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTTCT-ACTAGTCGGATA
Webervanbossea      GGCTCGGTAAAACAGCAATAATTTCTTCGATGTTAAT-ACTACTCGGATA
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Chy.verticillata    ACCGTAGTAATTCTAGAGCTAATATATGCCATTAA------GCGACGCAA
Gastroclonium       ACCGTAGTAATTCTAGAGCTAATATATGCCATTAA------GCGACGCAA
Chy.schneideri      ACCGTAGTAATTCTAGAGCTAATATATGCCACTAA------GAGACGCAA
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C.irregularis202    ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
C.irregularis203    ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
Coelothrix171       ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
C.harveyana177      ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
C.harveyana160      ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
Chharv194           ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
Ch.parvula173       ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGTAA
C.parvula198        ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGTAA
Ch.sali195          ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
C.sali161           ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAA------GCGACGCAA
Champia214          ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
Champia214a         ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
C.vieillardii       ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
Chviellar221        ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
C.vieillardii286    ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
Ch.affinis          ACCGTAGTAATTCTAGAGCTAATACGTGCCACTAT------GCGACGCAA
Dictyothamnion      ACCGTAGTAATTCTAGAGCTAATACGTGCCAATAA------ACGACGCAA
Hymenocladia        ACCGTAGTAATTCTAGAGCTAATACGTGCCATAAA------ACAGCGCAA
Erythrymenia        ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAG------ACGACGCAA
Abermudensis        ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAC------GCGACGCAA
Apeltata            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAC------GCGACGCAA
Asteranastomosans   ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAC------GCGACGCAA
Ch.nodulosa         ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.agardhii          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Gloiosaccion        ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Chornata            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Maripelta           ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAG------ACGACGCAA
Drouetia            ACCGTAGTAATTCTAGAGCTAATACGTGCCACATA------ACGACGCAA
Coelarthrum236      ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.clifton235        ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.cliftonii         ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
New genus           ACCGTATTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
New genus           ACCGTATTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Erythrocolon        ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAG------ACGACGCAA
Coelaopuntia        ACCGTAGTAATTCTAGAGCTAATACGTGCCAACAA------GCGACGCAA
Chamaebotrys231     ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAA------ACGACGCAA
Chamaebotrys232     ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAA------ACGACGCAA
Halichrysis         ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAA-------CGACGCAA
Hmicans             ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAAA-------CGACGCAA
B.iridescens        ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
B.irri              ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
B.spinulifera       ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Bspinulifera144     ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Leptosomia          ACCGTAGTAATTCTAGAGCTAATACGTGCTATGCA--------GACTCTC
Cephaleucobotrys    ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Cephafurcellata     ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Sparlingia          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Irvinea             ACCGTAGTAATTCTAGAGCTAATACGTGCCACATG-------CGACGCAA
Rhodymenia240       ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Rhodymenia          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Rhodyleptophylla    ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACTCAA
Epymenia            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Cordylecladia       ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Bwynnei218          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
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B.wynnei            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Bleptopoda          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------GCGACGCAA
Bebriosa            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------GCGACGCAA
Bsonderi            ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------GCGACGCAA
B.occidentalis      ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.wrightii          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.wrightii          ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.enteromorpha201   ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
C.enteromorpha143   ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Halymenia           ACCGTAGTAATTCTAGAGCTAATACGTGCCCTAAG------ACGACGCAA
Sebdenia            ACCGTAGTAATTCTAGAGCTAATACGTGCCTAAAT------GCGACGCAA
Fryeella            ACCGTAGTAATTCTAGAGCTAATACGTGCCAATAG------ACGACGCAA
Hymenocladiopsis    ACCGTAGTAATTCTAGAGCTAATACGTGCCACAAG------ACGACGCAA
Lomentaria183       ACCGTAGTAATTCTAGAGCTAATACGTACTTGTAG------TTTAC----
Lomentaria145       ACCGTAGTAATTCTAGAGCTAATACGTACTTGTAG------TTTAC----
Lombaileyana        ACCGTAGTAATTCTAGAGCTAATACGTACTTGTAG------TTTAC----
Lomaustralis        ACCGTAGTAATTCTAGAGCTAATACGTACTTGTAG------TTTAC----
Ceraintricat        ACCGTAGTAATTCTAGAGCTAATACGTACTTGTGGGACATTTTTATG-TC
Ceratodict          ACCGTAGTAATTCTAGAGCTAATACGTACTTGTGGGACATTTTTGT---C
Ceratodictyon       ACCGTAGTAATTCTAGAGCTAATACGTACTTGTGGGACTTTTTTTTG-TC
Semnocarpa          ACCGTAGTAATTCTAGAGCTAATACGTACTTGCGGGATTCGTTT------
Gloioderma          ACCGTAGTAATTCTAGAGCTAATACGTGCCTTTG--------CGACGCAA
Gloiocladi163       ACCGTAGTAATTCTAGAGCTAATACGTGCCTATTA------TCGACGCAA
G.furcata           ACCGTAGTAATTCTAGAGCTAATACGTGCCT-TTA------GCGACGCAA
Glaciniata          ACCGTAGTAATTCTAGAGCTAATACGTGCCA-TT-------GCGACGCAA
Grepens             ACCGTAGTAATTCTAGAGCTAATACGTGCCA-TTT------GCGACGCAA
Gloirepens          ACCGTAGTAATTCTAGAGCTAATACGTGCCA-TCA------GCGATGCAA
Faucheopsis         ACCGTAGTAATTCTAGAGCTAATACGTGCCAACCT------TCGACGCAA
Webervanbossea      ACCGTAGTAATTCTAGAGCTAATACGTGCCAAAC-------GCGACGCAA
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Chy.verticillata    GT-CG-TGGTATAAATTAAAGATACAAACCATCTCGGTGGTGATTCATAA
Gastroclonium       GT-CG-TGGTATAAATTAAAGATACAAACCATCTCGGTGGTGATTCATAA
Chy.schneideri      GT-TG-TTGTATAAATTGGAGATACAGACCATCTACATGGTGATTCAAAA
C.irregularis202    GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.irregularis203    GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Coelothrix171       GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.harveyana177      GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.harveyana160      GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Chharv194           GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Ch.parvula173       GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.parvula198        GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Ch.sali195          GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.sali161           GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Champia214          GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Champia214a         GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.vieillardii       GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Chviellar221        GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
C.vieillardii286    GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Ch.affinis          GT-CG-TGGTATAAATTGGAGATACAGACCATCATT-TGGTGATTCACAA
Dictyothamnion      GT-CG-TGGTATAAATTGGAGATACAAACCATCATT-TGGTGATTCACAA
Hymenocladia        GC-TG-TGGTATAAATTGGAGATACAAGCCAACAT-ATGGTGATTCACGA
Erythrymenia        GT-CG-TGGTATAAATTGGAGATACAAGCCGACAT-ATGGTGATTCACGA
Abermudensis        GT-CG-TGGTATAAATTGGAGATACAAGCCAACAT-ATGGTGATTCACGA
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Apeltata            GT-CG-TGGTATAAATTGGAGATACAAGCCAACAT-ATGGTGATTCACGA
Asteranastomosans   GT-CG-TGGTATAAATTGGAGATACAAGCCAACAT-ATGGTGATTCACGA
Ch.nodulosa         GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
C.agardhii          GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Gloiosaccion        GT-CG-TGGTATAAATTGGAGATACAAACCAACAA-TTGGTGATTCACGA
Chornata            GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Maripelta           GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Drouetia            GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACGA
Coelarthrum236      GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACAA
C.clifton235        GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACAA
C.cliftonii         GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACAA
New genus           GT-CG-TGGTATAAATTGGAGATACAGACCAACGT-TTGGTGATTCACGA
New genus           GT-CG-TGGTATAAATTGGAGATACAGACCAACGT-TTGGTGATTCACGA
Erythrocolon        GT-CG-TGGTATAAATTGGAGATACAGACCAACGT-TTGGTGATTCACGA
Coelaopuntia        GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACGA
Chamaebotrys231     GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACGA
Chamaebotrys232     GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACGA
Halichrysis         GT-CG-TGGTATAAATTGGAGATACAAACCAATAC-TTGGTGATTCACGA
Hmicans             GT-CG-TGGTATAAATTGGAGATACAAACCAATAC-TTGGTGATTCACGA
B.iridescens        GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
B.irri              GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
B.spinulifera       GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Bspinulifera144     GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Leptosomia          GT-TG-TGGTATAAGATGGAGATACAACCCAACTT-TTGATGATTCACAC
Cephaleucobotrys    GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACGA
Cephafurcellata     GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACGA
Sparlingia          GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACAA
Irvinea             GT-CG-TGGTATAAATTGGAGATACAAACCAACGT-TTGGTGATTCACGA
Rhodymenia240       GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACGA
Rhodymenia          GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACGA
Rhodyleptophylla    GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACAA
Epymenia            GT-CG-TGGTATAAATTGGAGATACAAACCAATAT-TTGGTGATTCACGA
Cordylecladia       GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACAA
Bwynnei218          GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
B.wynnei            GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Bleptopoda          GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACAA
Bebriosa            GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACAA
Bsonderi            GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACAA
B.occidentalis      GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
C.wrightii          GT-CG-TGGTATAAATTGGAGATACAGACCAACAT-TTGGTGATTCACGA
C.wrightii          GT-CG-TGGTATAAATTGGAGATACAGACCAACAT-TTGGTGATTCACGA
C.enteromorpha201   GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
C.enteromorpha143   GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Halymenia           GT-CG-TGGTATAAATTGGAGATACAAACCAATGT-TTGGTGATTCACGA
Sebdenia            GT-CG-TGGTATAAATTGGAGATACAAACCAATGT-TTGGTGATTCACGA
Fryeella            GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Hymenocladiopsis    GT-CG-TGGTATAAATTGGAGATACAAACCAACAT-TTGGTGATTCACGA
Lomentaria183       -TACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Lomentaria145       -TACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Lombaileyana        -TACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Lomaustralis        -TACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Ceraintricat        TTACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Ceratodict          TTACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
Ceratodictyon       TTACA-TGGTATAAATTAGATACACAAGCCAACTTGTTGGTGATTCATAA
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Semnocarpa          -CGCA-TGGTATAAATTAGATACACAAGCCAACTTTTTGGTGATTCATAA
Gloioderma          GT-CG-TGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATAA
Gloiocladi163       GT-CG-TGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATAA
G.furcata           GT-CG-CGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATGA
Glaciniata          GT-CG-CGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATGA
Grepens             GT-CG-CGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATGA
Gloirepens          AT-CG-CGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATGA
Faucheopsis         GT-CG-TGGTATAAATTAGATACACAAGCCAATTTATTGGTGATTCATAA
Webervanbossea      GT-CG-TGGTATAAATTAGATACACAAGCCAATTCATTGGTGATTCATAA
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Chy.verticillata    TTTACTTTCTGATTGCACTTTTAGT---GCGACACATCGATCAAATTTCT
Gastroclonium       TTTACTT-CTGATTGCACTTT--GT---GCGACACATCGATCAAATTTCT
Chy.schneideri      TTTAGTTTCTAATTGCGCCGAAAGG---GAGGTCCAGCGACCAAATTTCT
C.irregularis202    TTTCTTTTCTGATTGCACCGAAAGT---GCGACGCATCGTTCAAATTTCT
C.irregularis203    TTTCTTTTCTGATTGCACCGAAAGT---GCGACGCATCGTTCAAATTTCT
Coelothrix171       TTTCTTTTCTGATTGCACCGAAAGT---GCGACGCATCGTTCAAATTTCT
C.harveyana177      TTTCTTTTCTGATTGCACTATTAGT---GCGACGCATCGTTCAAATTTCT
C.harveyana160      TTTCTTTTCTGATTGCACTTTTAGT---GCGACGCATCGTTCAAATTTCT
Chharv194           TTTCTTTTCTGATTGCACTTTTAGT---GCGACGCATCGTTCAAATTTCT
Ch.parvula173       TTTCTTTTCTGATTGCACTATTAGT---GCGACGCATCGTTCAAATTTCT
C.parvula198        TTTCTTTTCTGATTGCATTATTAAT---GCGACGCATCGTTCAAATTTCT
Ch.sali195          TTTCTTTTCTGATTGCACTATTAGT---GCGACGCATCGTTCAAATTTCT
C.sali161           TTTCTTTTCTGATTGCACTATTAGT---GCGACGCATCGTTCAAATTTCT
Champia214          TTTCTTTTCTGATTGCATTTTTAAT---GCGACGCATCGTTCAAATTTCT
Champia214a         TTTCTTTTCTGATTGCATTTTTAAT---GCGACGCATCGTTCAAATTTCT
C.vieillardii       TTTCTTTTCTGATTGCATTTTTAAT---GCGACGCATCGTTCAAATTTCT
Chviellar221        TTTCTTTTCTGATTGCATTTTTAAT---GCGACGCATCGTTCAAATTTCT
C.vieillardii286    TTTCTTTTCTGATTGCATTTTTAAT---GCGACGCATCGTTCAAATTTCT
Ch.affinis          TTTCTTTTCTGATTGCACTTCTAGT---GCGACGCATCGTTCAAATTTCT
Dictyothamnion      TTTCTTTTCTGATTGCACTTTTAGT---GCGACGCATCGTTCAAATTTCT
Hymenocladia        TTTCTTTTCTGATTGCACTCA--GT---GCGACGCATCGTTCAAATTTCT
Erythrymenia        TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Abermudensis        TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Apeltata            TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Asteranastomosans   TTTCTTTTCTGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
Ch.nodulosa         TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
C.agardhii          TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Gloiosaccion        TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Chornata            TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Maripelta           TTTCTTTTCTGATTGCACTTTGTG----GCGACGCATCGTTCAAATTTCT
Drouetia            TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Coelarthrum236      TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
C.clifton235        TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
C.cliftonii         TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
New genus           TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
New genus           TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Erythrocolon        TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Coelaopuntia        TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Chamaebotrys231     TTTCTTTTCCGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
Chamaebotrys232     TTTCTTTTCCGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
Halichrysis         TTTCTTTTCCGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
Hmicans             TTTCTTTTCCGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
B.iridescens        TTTCTTTTCTGATTGCACTAT--GT---GCGACGCATCGTTCAAATTTCT
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B.irri              TTTCTTTTCTGATTGCACTA--TGT---GCGACGCATCGTTCAAATTTCT
B.spinulifera       TTTCTTTTCTGATTGCACTA--TGT---GCGACGCATCGTTCAAATTTCT
Bspinulifera144     TTTCTTTTCTGATTGCACTA--TGT---GCGACGCATCGTTCAAATTTCT
Leptosomia          TTTCTTTACGGATTACGCTTC-AGC---GTGACACATCGTTCAAATTTCT
Cephaleucobotrys    TTTCTTTTCTGATTGCACTAT--GT---GCGACGCATCGTTCAAATTTCT
Cephafurcellata     TTTCTTTTCTGATTGCACTAT--GT---GCGACGCATCGTTCAAATTTCT
Sparlingia          TTTCTTTTCTGATTGCACTAT--GT---GCGACGCATCGTTCAAATTTCT
Irvinea             TTTCTTTTCTGATTGCACTTT--GT---GCGACGCATCGTTCAAATTTCT
Rhodymenia240       TTTCTTTTCTGATTGCACTTT-CGT---GCGACGCATCGTTCAAATTTCT
Rhodymenia          TTTCTTTTCTGATTGCACTTT-CGT---GCGACGCATCGTTCAAATTTCT
Rhodyleptophylla    TTTCTTTTCTGATTGCACTTT-CGT---GCGACGCATCGTTCAAATTTCT
Epymenia            TTTCTTTTCTGATTGCACTTT-CGT---GCGACGCATCGTTCAAATTTCT
Cordylecladia       TTTCTTTTCTGATTGCACTTT-CGT---GCGACGCATCGTTCAAATTTCT
Bwynnei218          TTTCTTTTCTGATTGCACTAA-TGT---GCGACGCATCGTTCAAATTTCT
B.wynnei            TTTCTTTTCTGATTGCACTAA-TGT---GCGACGCATCGTTCAAATTTCT
Bleptopoda          TTTCTTTTCTGATTGCACTAA-TGT---GCGACGCATCGTTCAAATTTCT
Bebriosa            TTTCTTTTCTGATTGCATTAA-TGT---GCGACGCATCGTTCAAATTTCT
Bsonderi            TTTCTTTTCTGATTGCACTAA-TGT---GCGACGCATCGTTCAAATTTCT
B.occidentalis      TTTCTTTTCTGATTGCACTAA-TGT---GCGACGCATCGTTCAAATTTCT
C.wrightii          TTTCTTTTCTGATTGCACTTC-TGT---GCGACGCATCGTTCAAATTTCT
C.wrightii          TTTCTTTTCTGATTGCACTTC-TGT---GCGACGCATCGTTCAAATTTCT
C.enteromorpha201   TTTCTTTTCTGATTGCACTTA-TGT---GCGACGCATCGTTCAAATTTCT
C.enteromorpha143   TTTCTTTTCTGATTGCACTTA-TGT---GCGACGCATCGTTCAAATTTCT
Halymenia           TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Sebdenia            TTTCTTTTCTGATTGCACTCT--GT---GCGACGCATCGTTCAAATTTCT
Fryeella            TTTCTTTTCTGATTGCACTTT-TGT---GCGACGCATCGTTCAAATTTCT
Hymenocladiopsis    TTTCTTTTCTGATTGCA-TTT-TAT---GCGACGCATCGTTCAAATTTCT
Lomentaria183       TTTCTTTTCCGATCTTCATT---TG---AAGACGCATCGTTCAAATTTCT
Lomentaria145       TTTCTTTTCCGATCTTCATT---AG---AAGACGCATCGTTCAAATTTCT
Lombaileyana        TTTCTTTTCCGATCTTCATT---TG---AAGACGCATCGTTCAAATTTCT
Lomaustralis        TTTCTTTTCCGATCTTCATT---TG---AAGACGCATCGTTCAAATTTCT
Ceraintricat        TTTCTTTTCCGATCTCCTTCA--CG---GAGACGCATCGTTCAAATTTCT
Ceratodict          TTTCTTTTCCGATCTCCTTT---TG---GAGACGCATCGTTCAAATTTCT
Ceratodictyon       TTTCTTTTCCGATCTCCTTT---TG---GAGACGCATCGTTCAAATTTCT
Semnocarpa          TTTCTTTTCCGATCTCCTTTC--AG---GAGACGCATCGTTCAAATTTCT
Gloioderma          TTTCTTTTCCGATCGCATT---AAA---TCGACGCATCGTTCAAATTTCT
Gloiocladi163       TTTCTTTTCCGATCGCAAT---CTA---GCGACGCATCGTTCAAATTTCT
G.furcata           TTTCTTTTCCGATCGCAAAAC-CAT---GCGACACATCGTTCAAATTTCT
Glaciniata          TTTCTTTTCCGATCGCAAATC---T---GCGACGCATCGTTCAAATTTCT
Grepens             TTTCTTTTCCGATCGCAAAAC-AAT---GCGACGCATCGTTCAAATTTCT
Gloirepens          TTTCTTTTCCGATCGCAATG--AAT---GCGACGCATCGTTCAAATTTCT
Faucheopsis         TTTCTTTTCCGATCGCATTTC-------GCGACGCATCGTTCAAATTTCT
Webervanbossea      TTTCTTTTCGGATCGCCTTCG-G-----GCGACGCATCGTTCAAATTTCT
                    ***  ** *  **                 *    ** **  *********

Chy.verticillata    GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Gastroclonium       GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chy.schneideri      GGCCCATCAACTTTGGATGGTAAGGTATTGGCTTACCATGGTTTTGACGG
C.irregularis202    GACCTATCAACTTTGGATGGTAAGGTATTGGCTTACCATGGTTTTGACGG
C.irregularis203    GACCTATCAACTTTGGATGGTAAGGTATTGGCTTACCATGGTTTTGACGG
Coelothrix171       GACCTATCAACTTTGGATGGTAAGGTATTGGCTTACCATGGTTTTGACGG
C.harveyana177      GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.harveyana160      GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chharv194           GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
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Ch.parvula173	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.parvula198	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Ch.sali195	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.sali161	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Champia214	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Champia214a	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.vieillardii	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chviellar221	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.vieillardii286	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Ch.affinis	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Dictyothamnion	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Hymenocladia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Erythrymenia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Abermudensis	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Apeltata	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Asteranastomosans	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Ch.nodulosa	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.agardhii	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Gloiosaccion	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chornata	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Maripelta	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Drouetia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Coelarthrum236	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.clifton235	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.cliftonii	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
New genus	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
New genus	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Erythrocolon	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Coelaopuntia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chamaebotrys231	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Chamaebotrys232	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Halichrysis	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Hmicans	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
B.iridescens	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
B.irri	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
B.spinulifera	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Bspinulifera144	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Leptosomia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Cephaleucobotrys	GACCTATCAACTTTGGATGGTAAGGTTTTGTCTTACCATGGTTTTGACGG
Cephafurcellata	GACCTATCAACTTTGGATGGTAAGGTTTTGTCTTACCATGGTTTTGACGG
Sparlingia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Irvinea	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Rhodymenia240	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Rhodymenia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Rhodyleptophylla	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Epymenia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Cordylecladia	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Bwynnei218	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
B.wynnei	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Bleptopoda	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Bebriosa	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Bsonderi	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
B.occidentalis	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.wrightii	GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG

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C.wrightii          GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.enteromorpha201   GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
C.enteromorpha143   GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Halymenia           GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTGTGACGG
Sebdenia            GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Fryeella            GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Hymenocladiopsis    GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
Lomentaria183       GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Lomentaria145       GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Lombaileyana        GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Lomaustralis        GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Ceraintricat        GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Ceratodict          GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Ceratodictyon       GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Semnocarpa          GACCTATCAACTTTGTATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Gloioderma          GACCTATCAACTTTGGATGGTAAGGTAGAGTCTTACCATGGTTTTGACGG
Gloiocladi163       GACCTATCAACTTTGGATGGTAAGGTAGAGTCTTACCATGGTTTTGACGG
G.furcata           GACCTATCAACTTTTGATGGTAAGGTAGTGTCTTATCATGGTCTTGACGG
Glaciniata          GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Grepens             GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Gloirepens          GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Faucheopsis         GACCTATCAACTTTGGATGGTAAGGTAGTGTCTTACCATGGTTTTGACGG
Webervanbossea      GACCTATCAACTTTGGATGGTAAGGTATTGTCTTACCATGGTTTTGACGG
                    * ** *********  **********   * **** ******  ******

Chy.verticillata    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Gastroclonium       GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chy.schneideri      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.irregularis202    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.irregularis203    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Coelothrix171       GTAACGGACCGTGGGTGCGGGATTCCGGAGAAGGAGCCTGAGAAACGGCT
C.harveyana177      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.harveyana160      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chharv194           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Ch.parvula173       GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.parvula198        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Ch.sali195          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.sali161           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Champia214          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Champia214a         GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.vieillardii       GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chviellar221        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.vieillardii286    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Ch.affinis          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Dictyothamnion      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Hymenocladia        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Erythrymenia        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAGACGGCT
Abermudensis        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Apeltata            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Asteranastomosans   GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Ch.nodulosa         GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.agardhii          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Gloiosaccion        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chornata            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
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Maripelta           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Drouetia            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Coelarthrum236      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.clifton235        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.cliftonii         GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
New genus           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
New genus           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Erythrocolon        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAGCGGCT
Coelaopuntia        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chamaebotrys231     GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Chamaebotrys232     GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Halichrysis         GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Hmicans             GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
B.iridescens        GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
B.irri              GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
B.spinulifera       GTAACGGACCGTGGGTGCGGGACTCCGGAGAGGGAGCCTGAGAAACGGCT
Bspinulifera144     GTAACGGACCGTGGGTGCGGGACTCCGGAGAGGGAGCCTGAGAAACGGCT
Leptosomia          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Cephaleucobotrys    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Cephafurcellata     GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Sparlingia          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Irvinea             GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Rhodymenia240       GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Rhodymenia          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Rhodyleptophylla    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Epymenia            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Cordylecladia       GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Bwynnei218          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
B.wynnei            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Bleptopoda          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Bebriosa            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Bsonderi            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
B.occidentalis      GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.wrightii          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.wrightii          GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.enteromorpha201   GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
C.enteromorpha143   GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Halymenia           GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Sebdenia            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAGACGGCT
Fryeella            GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Hymenocladiopsis    GTAACGGACCGTGGGTGCGGGATTCCGGAGAGGGAGCCTGAGAAACGGCT
Lomentaria183       GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Lomentaria145       GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Lombaileyana        GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Lomaustralis        GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Ceraintricat        GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Ceratodict          GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Ceratodictyon       GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Semnocarpa          GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Glioderma           GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Gloiocladi163       GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAGACGGCT
G.furcata           GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Glaciniata          GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Grepens             GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
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Gloirepens          GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
Faucheopsis         GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGATCCTGAGAAACGGCT
Webervanbossea      GTAACGGACCGTGGGTGCGGGGTTCCGGAGAGGGAGCCTGAGAAACGGCT
                    *********************  ******** *** *******  *****


Chy.verticillata    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
Gastroclonium       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
Chy.schneideri      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACC
C.irregularis202    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
C.irregularis203    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
Coelothrix171       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
C.harveyana177      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.harveyana160      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Chharv194           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Ch.parvula173       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACGCC
C.parvula198        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACGCC
Ch.sali195          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.sali161           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Champia214          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
Champia214a         ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCTGACACA
C.vieillardii       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Chviellar221        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.vieillardii286    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Ch.affinis          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Dictyothamnion      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Hymenocladia        ACCACATCCAAGGAAGGCAGCAGGCGCGTAAATTACCCACTCCGGACACC
Erythrymenia        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Abermudensis        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Apeltata            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Asteranastomosans   ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Ch.nodulosa         ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.agardhii          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Gloiosaccion        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Chornata            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Maripelta           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Drouetia            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Coelarthrum236      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.clifton235        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.cliftonii         ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
New genus           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
New genus           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Erythrocolon        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Coelaopuntia        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Chamaebotrys231     ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Chamaebotrys232     ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Halichrysis         ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Hmicans             ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
B.iridescens        ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
B.irri              ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
B.spinulifera       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Bspinulifera144     ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Leptosomia          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Cephaleucobotrys    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACGCC
Cephafurcellata     ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACGCC
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Sparlingia          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Irvinea             ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Rhodymenia240       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Rhodymenia          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Rhodyleptophylla    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Epymenia            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Cordylecladia       ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Bwynnei218          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
B.wynnei            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Bleptopoda          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Bebriosa            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Bsonderi            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
B.occidentalis      ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.wrightii          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.wrightii          ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.enteromorpha201   ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
C.enteromorpha143   ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Halymenia           ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Sebdenia            ACCACATCCAAGGAAGGCAGCAGGCGCGCAACTTACCCAATCCGGACGCC
Fryeella            ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Hymenocladiopsis    ACCACATCCAAGGAAGGCAGCAGGCGCGCAAATTACCCAATCCGGACACC
Lomentaria183       ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Lomentaria145       ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Lombaileyana        ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Lomaustralis        ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Ceraintricat        ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Ceratodict          ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Ceratodictyon       ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGAAATCC
Semnocarpa          ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCTAAAGCA
Gloioderma          ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Gloiocladi163       ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
G.furcata           ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Glaciniata          ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Grepens             ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Gloirepens          ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Faucheopsis         ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
Webervanbossea      ACCACATCCAAGGAAGGCAGCAGGCGCGTAACTTACCCAATCCGGACACC
                    **************************** ** ******* ***  *  *

Chy.verticillata    GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Gastroclonium       GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Chy.schneideri      GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.irregularis202    GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.irregularis203    GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Coelothrix171       GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.harveyana177      GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
C.harveyana160      GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Chharv194           GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Ch.parvula173       GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
C.parvula198        GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Ch.sali195          GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
C.sali161           GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAA
Champia214          GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Champia214a         GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
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C.vieillardii	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Chviellar221	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.vieillardii286	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Ch.affinis	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Dictyothamnion	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGCTGGGTTTTCTAAT
Hymenocladia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Erythrymenia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Abermudensis	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Apeltata	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Asteranastomosans	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Ch.nodulosa	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.agardhii	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Gloiosaccion	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Chornata	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Maripelta	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Drouetia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Coelarthrum236	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCTAATGGGTTTTCTAAT
C.clifton235	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCTAATGGGTTTTCTAAT
C.cliftonii	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCTAATGGGTTTTCTAAT
New genus	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
New genus	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Erythrocolon	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Coelaopuntia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Chamaebotrys231	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Chamaebotrys232	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Halichrysis	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Hmicans	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
B.iridescens	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
B.irri	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
B.spinulifera	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATCGGTTTTCTAAT
Bspinulifera144	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATCGGTTTTCTAAT
Leptosomia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGAAGGGTTTTCTAAT
Cephaleucobotrys	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGAAGGGTTTTCTAAT
Cephafurcellata	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Sparlingia	GGGAGGTAGTGACAAAAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Irvinea	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Rhodymenia240	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Rhodymenia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Rhodyleptophylla	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Epymenia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Cordylecladia	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Bwynnei218	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
B.wynnei	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Bleptopoda	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Bebriosa	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCAATGGGTTTTCTAAT
Bsonderi	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
B.occidentalis	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.wrightii	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.wrightii	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.enteromorpha201	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
C.enteromorpha143	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Halymenia	GGGAGGTAGTGACAAGAAATAGCAATAGAGGGCCCGATGGGTTTTCTAAT
Sebdenia	GGGAGGTAGTGACAAGAAATAGCAATAGAGGGCCCGATGGGTTTTCTAAT
Fryeella	GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT

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Hymenocladiopsis    GGGAGGTAGTGACAAGAAATATCAATAGAGGGCCCGATGGGTTTTCTAAT
Lomentaria183       GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Lomentaria145       GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Lombaileyana        GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Lomaustralis        GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Ceraintricat        GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Ceratodict          GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Ceratodictyon       GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Semnocarpa          GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Gloioderma          GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Gloiocladi163       GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
G.furcata           GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Glaciniata          GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Grepens             GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Gloirepens          GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Faucheopsis         GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
Webervanbossea      GGGAGGTAGTGACAAGAAATATCAATAGAGGACCCAATGGGTCTTCTAAT
                    *************** ***** ********* **     *** ******

Chy.verticillata    TGGAATGAGAACAAGCTAAACAGCTTATCGAGGATCCAGCAGAGGGCAAG
Gastroclonium       TGGAATGAGAACAAGCTAAACAGCTTATCGAGGATCCAGCAGAGGGCAAG
Chy.schneideri      TGGAATGAGAACAAGCTAAACAGCTTATCGAGGATCCAGCAGAGGGCAAG
C.irregularis202    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.irregularis203    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Coelothrix171       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.harveyana177      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.harveyana160      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Chharv194           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Ch.parvula173       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.parvula198        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Ch.sali195          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.sali161           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Champia214          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Champia214a         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.vieillardii       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Chviellar221        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.vieillardii286    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Ch.affinis          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Dictyothamnion      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Hymenocladia        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Erythrymenia        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Abermudensis        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Apeltata            TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Asteranastomosans   TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Ch.nodulosa         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.agardhii          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Gloiosaccion        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Chornata            TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Maripelta           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Drouetia            TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Coelarthrum236      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.clifton235        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.cliftonii         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
New genus           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
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New genus          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Erythrocolon       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Coelaopuntia       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Chamaebotrys231    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Chamaebotrys232    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Halichrysis        TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Hmicans            TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
B.iridescens       TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
B.irri             TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
B.spinulifera      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Bspinulifera144    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Leptosomia         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Cephaleucobotrys   TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Cephafurcellata    TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Sparlingia         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Irvinea            TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Rhodymenia240      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Rhodymenia         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Rhodyleptophylla   TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Epymenia           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Cordylecladia      TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Bwynnei218         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
B.wynnei           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Bleptopoda         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Bebriosa           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Bsonderi           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
B.occidentalis     TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.wrightii         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.wrightii         TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.enteromorpha201  TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
C.enteromorpha143  TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Halymenia          TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Sebdenia           TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Fryeella           TGGAATGAGAACAAGGTAAATAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Hymenocladiopsis   TGGAATGAGAACAAGGTAAACAGCTTATCGAGGAGCCAGCAGAGGGCAAG
Lomentaria183      TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Lomentaria145      TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Lombaileyana       TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Lomaustralis       TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Ceraintricat       TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Ceratodict         TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Ceratodictyon      TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Semnocarpa         TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Gloioderma         TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCTAGCAGAGGGCAAG
Gloiocladi163      TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCTAGCAGAGGGCAAG
G.furcata          TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Glaciniata         TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Grepens            TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Gloirepens         TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
Faucheopsis        TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCCGAGGGCAAG
Webervanbossea     TGGAATGAGAACAAGGTAAACATCTTATCGAGGATCCAGCAGAGGGCAAG
                   *************** **** * *********** * *** *********

Chy.verticillata   TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
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Gastroclonium	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chy.schneideri	TCTGGTGCCAGCAGCCGCGGTAATTCCAGGTCTGTAAGCGTATACCAAAG
C.irregularis202	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.irregularis203	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Coelothrix171	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.harveyana177	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.harveyana160	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chharv194	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ch.parvula173	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.parvula198	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ch.sali195	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.sali161	TCTAGTGCCACCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Champia214	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Champia214a	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.vieillardii	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chviellar221	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.vieillardii286	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ch.affinis	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Dictyothamnion	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Hymenocladia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Erythrymenia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Abermudensis	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Apeltata	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Asteranastomosans	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ch.nodulosa	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.agardhii	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Gloiosaccion	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chornata	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Maripelta	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Drouetia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Coelarthrum236	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.clifton235	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.cliftonii	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
New genus	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
New genus	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Erythrocolon	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Coelaopuntia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chamaebotrys231	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Chamaebotrys232	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Halichrysis	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Hmicans	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
B.iridescens	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
B.irri	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
B.spinulifera	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Bspinulifera144	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Leptosomia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Cephaleucobotrys	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Cephafurcellata	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Sparlingia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Irvinea	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Rhodymenia240	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Rhodymenia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Rhodyleptophylla	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Epymenia	TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG

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Cordylecladia       TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Bwynnei218          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
B.wynnei            TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Bleptopoda          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Bebriosa            TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Bsonderi            TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
B.occidentalis      TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.wrightii          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.wrightii          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.enteromorpha201   TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
C.enteromorpha143   TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Halymenia           TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Sebdenia            TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Fryeella            TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Hymenocladiopsis    TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Lomentaria183       TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Lomentaria145       TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Lombaileyana        TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Lomaustralis        TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ceraintricat        TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ceratodict          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Ceratodictyon       TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Semnocarpa          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Gloioderma          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Gloiocladi163       TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
G.furcata           TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Glaciniata          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Grepens             TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Gloirepens          TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Faucheopsis         TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
Webervanbossea      TCTGGTGCCAGCAGCCGCGGTAATTCCAGCTCTGTAAGCGTATACCAAAG
                    *** ****** ****************** ********************

Chy.verticillata    TTGTTGCAGTTAAAACGCTCGTAGTCGAAACTTGGCGGATGAATTGCTTA
Gastroclonium       TTGTTGCAGTTAAAACGCTCGTAGTCGAAACTTGGCGGATGAATTGCTTA
Chy.schneideri      TTGTTACAGTTAAAACGCTCGTAGTCGCAACTTGGCGGATGAATTGCTTA
C.irregularis202    TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGACAATTTGCTTC
C.irregularis203    TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGACAATTTGCTTC
Coelothrix171       TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGACAATTTGCTTC
C.harveyana177      TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATTTGCTTC
C.harveyana160      TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATTTGCTTC
Chharv194           TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATTTGCTTC
Ch.parvula173       TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGACTTGCTTC
C.parvula198        TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGACTTGCTTC
Ch.sali195          TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGATGACTTGCTTC
C.sali161           TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGATGACTTGCTTC
Champia214          TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGGTGAGCAAC
Champia214a         TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGGTGAGCAAC
C.vieillardii       TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGGTGAGCAAC
Chviellar221        TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATGAGCAAC
C.vieillardii286    TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATGAGCAAC
Ch.affinis          TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGATGAGCAAC
Dictyothamnion      TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGAGGGTATGCTTC
Hymenocladia        TTGTTGCAGTTAAAACGCTCGTAGTCGGAATTTGGCGGGCGACTTGCTTC
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Erythrymenia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
Abermudensis	TTGTTGCAGTTAAAACGCTCGTAGTCGGAAGTTGGCGGGCGATTTGCTTC
Apeltata	TTGTTGCAGTTAAAACGCTCGTAGTCGGAAGTTGGCGGGCGATTTGCTTC
Asteranastomosans	TTGTTGCAGTTAAAACGCTCGTAGTCGGAAGTTGGCGGGCGATTTGCTTC
Ch.nodulosa	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCTAC
C.agardhii	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCTAC
Gloiosaccion	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCTAC
Chornata	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCTAC
Maripelta	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTAC
Drouetia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCTC
Coelarthrum236	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
C.clifton235	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
C.cliftonii	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
New genus	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
New genus	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
Erythrocolon	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
Coelaopuntia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCAACTTGCCAC
Chamaebotrys231	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
Chamaebotrys232	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
Halichrysis	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCAATTTGCCAC
Hmicans	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCAC
B.iridescens	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCAC
B.irri	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCAC
B.spinulifera	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCAC
Bspinulifera144	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCAC
Leptosomia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGATGCCTTGTCAC
Cephaleucobotrys	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGACTTGCCAC
Cephafurcellata	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGACTTGCCAG
Sparlingia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGACTTGCCAC
Irvinea	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGGCGATTTGCCAC
Rhodymenia240	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCCTC
Rhodymenia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGTGACTTGCCTC
Rhodyleptophylla	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGACTTGCCTC
Epymenia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGACTTGCCTC
Cordylecladia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGACTTGCCTC
Bwynnei218	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
B.wynnei	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
Bleptopoda	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTCCTTC
Bebriosa	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
Bsonderi	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
B.occidentalis	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
C.wrightii	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
C.wrightii	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
C.enteromorpha201	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
C.enteromorpha143	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGCGGGCGATTTGCTTC
Halymenia	TTGTTGCAGTTAAAACGCTCGTAGTCGAAATTTGGCGGGCGACTTAAGTC
Sebdenia	TTGTTGCAGTTAAAACGCTCGTAGTCGGAAGTTGGCGGGCGATTTGGGGC
Fryeella	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGACGATTTGGTAC
Hymenocladiopsis	TTGTTGCAGTTAAAACGCTCGTAGTCGGAACTTGGTGGTCGATTTGCCTC
Lomentaria183	TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTT
Lomentaria145	TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTT
Lombaileyana	TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTC
Lomaustralis	TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTC
Ceraintricat	TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGATTGTTTTGCGTC

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Ceratodict          TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTC
Ceratodictyon       TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGTTGTTTTGCGTC
Semnocarpa          TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGTGGTTGTTTCGCGTT
Gloioderma          TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCGATCTGCATC
Gloiocladi163       TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCGATCTGCATC
G.furcata           TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGTGGGCGATTTGCATC
Glaciniata          TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCGATTTGCATC
Grepens             TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCCATTTGCATC
Gloirepens          TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGTGGGCGATTTGCATC
Faucheopsis         TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCGATTTGCATC
Webervanbossea      TTGTTGCAGTTAAAACGCTCGTAGTCGAACCTTGGCGGGCGATTTGCATC
                    ***** ********************* *  **** *

Chy.verticillata    GTCCTCACGGATGTTAGCGAGTCAGCCGCCTTAGTGGAGGGCGGTCTAGT
Gastroclonium       GTCCTCACGGATGTTAGCGAGTCAGCCGCCTTAGTGGAGGGCGGTCTAGT
Chy.schneideri      ATCCTCATGGAAATTAGTGGGTCAGACGCCTTGGTGGAGGGCGTTTTAGA
C.irregularis202    GTCCTCACGGATGGTAGCAAATTGGCCGCCTTTGTGGAGGGTGACCTACT
C.irregularis203    GTCCTCACGGATGGTAGCAAATTGGCCGCCTTTGTGGAGGGTGACCTACT
Coelothrix171       GTCCTCACGGATGGTAGCAAATTGGCCGCCTTTGTGGAGGGTGACCTACT
C.harveyana177      GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
C.harveyana160      GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
Chharv194           GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
Ch.parvula173       GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
C.parvula198        GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
Ch.sali195          GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
C.sali161           GTCCTCACGGATGGTAGCAGGTCAGCCGCCTTTGTGGAGGGTGGTCTACT
Champia214          GTCTTCATTGACGGTAGTTTACCAAACGCCTTTGTGGAGGGTGGCCTACT
Champia214a         GTCTTCATTGACGGTAGTTTACCAAACGCCTTTGTGGAGGGTGGCCTACT
C.vieillardii       GTCTTCATTGACGGTAGTTTATCAAACGCCTTTGTGGAGGGTGGCCTACT
Chviellar221        GTCTTCATTGACGGTAGTTTATCAAACGCCTTTGTGGAGGGTGGTCTACT
C.vieillardii286    GTCTTCATTGACGGGAGTTTATCAAACGCCTTTGTGGAGGGTGGTCTACT
Ch.affinis          GTCTTCATTGACGGTAGTTTATCAAACGCCTTTGTGGAGGGTGGTCTACT
Dictyothamnion      GTCCTCACGGACGTTTGCAGATCAGCCGCCTTTGTGGAGGGTGGTCTAGA
Hymenocladia        GTCCTCGCGGATGCTCGCAAGTCGACCGCCTTTGTGGAGGGGGGCCCGGA
Erythrymenia        GTCCTCGCGGATGCTTGCAAGTCGACCGCCTTTGTGGAGGGGGGCCTAGT
Abermudensis        GTCCTCGCGGATGCTTGCAGGTCGACCGCCTTTGTGGATGGCGACCTAGT
Apeltata            GTCCTCGCGGATGCTTGCAGGTCGACCGCCTTTGTGGATGGCGACCTAGT
Asteranastomosans   GTCCTCGCGGATGCTTGCAGGTCGACCGCCTTTGTGGATGGCGACCTAGT
Ch.nodulosa         ATTCGCAAGAATGATGGCAGATCGGCCGCCTTTGTGGATGGGGGCCTAGT
C.agardhii          ATTCGCAAGAATGATGGCAGATCGGCCGCCTTTGTGGATGGGGGCCTAGT
Gloiosaccion        ATTCGCAAGAATGATGGCAGATCGGCCGCCTTTGTGGATGGGGGCCTAGT
Chornata            ATTCGCAAGAATGATGGCAGGTCGGCCACCTTTGTGGATGGGGGCCTAGT
Maripelta           ATTCGCAAGAATGATTGCAAATCGGCCGCCTTTGTGGATGGGGGTCTAGT
Drouetia            GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCCAGT
Coelarthrum236      GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGATCCAGT
C.clifton235        GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGATCCAGT
C.cliftonii         GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGATCCAGT
New genus           GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGGGATCTAGT
New genus           GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGGGATCTAGT
Erythrocolon        GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGATCTAGT
Coelaopuntia        GTCCTCGCGGACGTCGGCAGGTTGGCCGCCTTTGTGGAGGGGGATCTAGT
Chamaebotrys231     GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGGGGTCTAGT
Chamaebotrys232     GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGGGGTCTAGT
Halichrysis         GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGTGGTCTAGT
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Hmicans             GTCCTCGCGGACGTCGGCAGATCGGCCGCCTTTGTGGAGGGTGTTCTTGT
B.iridescens        GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGGTCTAGT
B.irri              GTCCTCGCGGACGTCGGCAGGTCGGCCGCCTTTGTGGAGGGGGGTTTAGT
B.spinulifera       ATCCTCGCGGACGTCGGCAAGTCGGCCGCCTTTGTGGAGGGGGATCTAGT
Bspinulifera144     ATCCTCGCGGACGTCGGCAAGTCGGCCGCCTTTGTGGAGGGGGATCTAGT
Leptosomia          GTCCTCGCGGACGGAGGCCGGGCAGTCGCTTTAGTGGAGGGCGATCTGGT
Cephaleucobotrys    GTCCTCGCGGACGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGTCTAGT
Cephafurcellata     GTCCTCGCGGACGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGTCTAGT
Sparlingia          ATCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Irvinea             GTCCTCGCGGACGTCGGCAAGTCGGCCGCCTTTGTGGAGGGGGGTCTAGT
Rhodymenia240       GTCCTCGCGGATGTTGGCAGATCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Rhodymenia          GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Rhodyleptophylla    GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Epymenia            GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Cordylecladia       GTCCTTGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Bwynnei218          TTCCTCGCGGATGTTGGCAAGGCGGCCGCCTTTGTGGAGGGGGGCCTAGT
B.wynnei            GTCCTCGCGGATGTTGGCAAGGCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Bleptopoda          GTCCTCGCGGATGTTGGGAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Bebriosa            GTCCTCGCGGATGTTGGGAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Bsonderi            GTCCTCGCGGATGTTGGCAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
B.occidentalis      GTCCTCGCGGATGTTGGCAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
C.wrightii          GTCCTCGCGGATGTTGGCAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
C.wrightii          GTCCTCGCGGATGTTGGCAAGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
C.enteromorpha201   GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
C.enteromorpha143   GTCCTCGCGGATGTTGGCAGGTCGGCCGCCTTTGTGGAGGGGGGCCTAGT
Halymenia           GTCTTTACCGACGATCTTAGGTTGGCCGCCTTTGTGGAGGGGGGCCTAGT
Sebdenia            GTCCTCGCGGATGTTCTCAGATCGGCCGCCTTTGTGGATGGGGGCCTAGT
Fryeella            ATCCTCGCGGATGTTTCCAGGTCGACTGCCTTTGTGGAGGGGAATCTAGT
Hymenocladiopsis    ATCCTCGCGGATGGGTGCAGGTCGATTGCCTTTGTGGAGGGGGGCCTAGT
Lomentaria183       ATCCTCACGGATGGCTGTGATCCGGCCGCCTTTGTGGAGGGGGATGTAGT
Lomentaria145       ATCCTCACGGATGGCTGTGATCCGGCCGCCTTTGTGGAGGGGGATGTAGT
Lombaileyana        ATCCTCACGGATGGCTGTGATCCGGCCGCCTTTGTGGAGGGGGGTGTAGT
Lomaustralis        ATCCTCACGGATGTCTGTAATCCGGCCGCCTTTGTGGAGGGGGATGTAGT
Ceraintricat        ATCCTCACGGATGGCTGTGATTCGGCCGCCTTTGTGGAGGGGGGTGTAGT
Ceratodict          GTCCTCACGGATGGCTGTGATTCGGCCGCCTTTGTGGAGGGGGGTGTAGT
Ceratodictyon       ATCCTCACGGATGGCTGTGAATCGTCCGCCTTTGTGGAGGGGGGTGCAGC
Semnocarpa          ATCCTCGCGGATGGCTGTGATTCGGCCGCCTTTGTGGAGGGGGGTGTAGT
Gloioderma          GTCCTCGCGGACGCTTGTAGGTCGACCGCCTTCGTGGAGGGGTGCTCAGC
Gloiocladi163       GTCCTCGCGGACGCTTGTAGGTCGACCGCCTTCGTGGAGGGGTGCTCAGC
G.furcata           GTCCTCGCGGACGCTTGTAGGTCGACCGCCTTCGTGGAGGGGGGTGTAGC
Glaciniata          GTCCTCGCGGACGTTTGTAAGTCGACCGCCTTCGTGGAGGGGGGTGTAGC
Grepens             GTCCTCGCGGATGTTTGTAGGTAGACCGCCTTCGTGGAGGGGGGTGTAGC
Gloirepens          GTCTTCGCGGATGTTTGTAGGTCGACCGCCTTCGTGGAGGGGGGTGTAGC
Faucheopsis         GTCCTCGCGGATGTTTGTAGATCGACCGCCTTCGTGGAGGGGGGTGTTGC
Webervanbossea      GTCCTCGCGGATGTTTGTAGATCGACCGCCTTCGTGGAGGGGGGTGTAGC
                     *        *                 * ** ***** **

Chy.verticillata    GGTCCTTTACTGGA-TTGTTGGATTGCTGCCACCATTTACTGTGAAAAAA
Gastroclonium       GGTCCTTTACTGGA-TTGTTAGATTGCTGCCACCATTTACTGTGAAAAAA
Chy.schneideri      GGTCCTTTACTGGA-TGATTGAGTTGCCGCCACCATTTACTGTGAAAAAA
C.irregularis202    GGTTCTTTACTGAA-TCGTTAGGTTGCTGCCACCATTTACTGTGAAAAAA
C.irregularis203    GGTTCTTTACTGAA-TCGTTAGGTTGCTGCCACCATTTACTGTGAAAAAA
Coelothrix171       GGTTCTTTACTGAA-TCGTTAGGTTGCTGCCACCATTTACTGTGAAAAAA
C.harveyana177      GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
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C.harveyana160	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
Chharv194	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
Ch.parvula173	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
C.parvula198	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
Ch.sali195	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
C.sali161	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
Champia214	GGTCCTTTACTGAA-TCGATAGGTCGCTGCCACCATTTACTGTGAAAAAA
Champia214a	GGTCCTTTACTGAA-TCGATAGGTCGCTGCCACCATTTACTGTGAAAAAA
C.vieillardii	GGTTCTTTACTGAA-TCGATAGGTCGCTGCCACCATTTACTGTGAAAAAA
Chviellar221	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
C.vieillardii286	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCATTTACTGTGAAAAAA
Ch.affinis	GGTTCTTTACTGAA-TCGATAGATCGCTGCCACCTTTTACTGTGAAAAAA
Dictyothamnion	GGTTCTTCACTGGA-TCACTAGATCGCTGCCACCTTTTACTGTGAAAAAA
Hymenocladia	GAATCTTAAATGAG-TCGCTGGGTCACTGCCACCGTTTACTGTGAAAAAA
Erythrymenia	GGCTCTTTACTGAT-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Abermudensis	GGCTCTTTGTTGAA-TTGCTAGGCCGCTGCCACCGTTTACTGTGAAAAAA
Apeltata	GGCTCTTTGTTGAA-TTGCTAGGCCGCTGCCACCGTTTACTGTGAAAAAA
Asteranastomosans	GGCTCTTTATTGAA-TTGCTAGGCCGCTGCCACCGTTTACTGTGAAAAAA
Ch.nodulosa	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.agardhii	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Gloiosaccion	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Chornata	GGTTCTTTACTGCA-TCGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
Maripelta	GGTTCTTTACTGAAATTGCTAGGCCGCTGCCACCGTTTACTGTGAAAAAA
Drouetia	GGTTCTTTACTGCA-TTGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
Coelarthrum236	GGTTCTTCACTGCA-TCGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.clifton235	GGTTCTTCACTGCA-TCGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.cliftonii	GGTTCTTCACTGCA-TCGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
New genus	GGTTCTTTACTGCA-TTGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
New genus	GGTTCTTTACTGCA-TTGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Erythrocolon	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Coelaopuntia	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Chamaebotrys231	GGTTCTTTACTGCA-TCGCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Chamaebotrys232	GGTTCTTTACTGCA-TCGCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Halichrysis	GGTTCTTTACTGCA-TCTCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Hmicans	GGTTCTTCACTGCA-TCGCAAGATCGCTGCCACCGTTTACTGTGAAAAAA
B.iridescens	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
B.irri	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
B.spinulifera	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Bspinulifera144	GGTTCTTCACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Leptosomia	GGTTCTTTATTGAA-TCACTAGAGCGCTGCCACCGTTTACTGTGAAAAAA
Cephaleucobotrys	GGTTCTTTACTGCA-TCGCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Cephafurcellata	GGTTCTTTACTGCA-TCGCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Sparlingia	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Irvinea	GGTCCTTTACTGGA-TTGCTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Rhodymenia240	GGTTCTTTACTGCA-TCGTTAGATCGCTGCCACCGTTTACTGTGAAAAAA
Rhodymenia	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Rhodyleptophylla	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Epymenia	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Cordylecladia	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Bwynnei218	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
B.wynnei	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Bleptopoda	GGTTCTTTACTGCA-TCGCTGGGTCGCTGCCACCGTTTACTGTGAAAAAA
Bebriosa	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Bsonderi	GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA

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B.occidentalis      GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.wrightii          GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.wrightii          GGTCTTTACTGCAA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.enteromorpha201   GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
C.enteromorpha143   GGTTCTTTACTGCA-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Halymenia           GGTGCTTAACCGCT-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Sebdenia            GGTGCTTTACTGCC-TCGCTAGGTCGCTGCCACCGTTTACTGTGAAAAAA
Fryeella            GGTTCTTCATTGCA-TCGCTAGGTTTCTGCCACCGTTTACTGTGAAAAAA
Hymenocladiopsis    GGTTCTTTACTGCA-TCGCTAAGTCTCTGCCACCGTTTACTGTGAAAAAA
Lomentaria183       GGTTCTTTACTGAA-TTACTGCGTTTCCGCCACCGTCTACTGTGAAAAAA
Lomentaria145       GGTTCTTTACTGAA-TTACTGCGTTTCCGCCACCGTCTACTGTGAAAAAA
Lombaileyana        GGTTCTTTACTGAA-TTACTGCATTTCCGCCACCTTCTACTGTGAAAAAA
Lomaustralis        GGTTCTTTACTGAA-TTACTGCGTTTCCGCCACCGTCTACTGTGAAAAAA
Ceraintricat        GGTTCTTTACTGAA-TTACTGCATTTCCGCCACCGTCTACTGTGAAAAAA
Ceratodict          GGTTCTTTACTGAA-TTACTGCATTTCCGCCACCGTCTACTGTGAAAAAA
Ceratodictyon       GGTTCTTCACTGAA-TTACTGCATTTCCGCCACCGTCTACTGTGAAAAAA
Semnocarpa          GGTTCTTCACTGAA-TTACTGCATTTCCGCCACCGTCTACTGTGAAAAAA
Gloioderma          GGCTCTTTACTGAG-TCACTGCGTGTCCGCCACCGTCTACTGTGAAAAAA
Gloiocladi163       GGCTCTTTACTGAG-TCATTGCGTGTCCGCCACCGTCTACTGTGAAAAAA
G.furcata           GGTTCTTCACTGAA-TCACTTCATTTCCGCCACCGTCTACTGTGAAAAAA
Glaciniata          GGTTCTTCACTGAA-TCACTTCATTTCCGCCACCGTCTACTGTGAAAAAA
Grepens             GGTTCTTCACTGAA-TCACTTCATTTCCGCCACCGTCTACTGTGAAAAAA
Gloirepens          GGTTCTTCACTGAA-TCACTTCATTTCCGCCACCGTCTACTGTGAAAAAA
Faucheopsis         GGTTCTTCACTGAA-TCACTTCATTTCCGCCACCGTCTACTGTGAAAAAA
Webervanbossea      GGTTCTTCACTGAA-TTACTATATTTCCGCCACCGTCTACTGTGAAAAAA
                    *   ***    *   *          * ****** * *************

Chy.verticillata    TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Gastroclonium       TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chy.schneideri      ATAGAGTGTTCAAAACAGGCGTTGGCCGTGAATACATTAGCATGGAATAA
C.irregularis202    TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.irregularis203    TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Coelothrix171       TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGGATAA
C.harveyana177      TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.harveyana160      TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chharv194           TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Ch.parvula173       TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.parvula198        TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Ch.sali195          TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.sali161           TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Champia214          TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Champia214a         TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.vieillardii       TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chviellar221        TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.vieillardii286    TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Ch.affinis          TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Dictyothamnion      TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Hymenocladia        TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Erythrymenia        TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Abermudensis        TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Apeltata            TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Asteranastomosans   TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Ch.nodulosa         TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.agardhii          TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
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Gloiosaccion	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chornata	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Maripelta	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Drouetia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Coelarthrum236	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.clifton235	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.cliftonii	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
New genus	TTAGAGTGTTCAAAGCAGGCATTTGCCCTGAATACATTAGCATGGAATAA
New genus	TTAGAGTGTTCAAAGCAGGCATTTGCCCTGAATACATTAGCATGGAATAA
Erythrocolon	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Coelaopuntia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chamaebotrys231	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Chamaebotrys232	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Halichrysis	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Hmicans	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
B.iridescens	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
B.irri	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
B.spinulifera	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Bspinulifera144	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Leptosomia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACACTAGCATGGAATAA
Cephaleucobotrys	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Cephafurcellata	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Sparlingia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Irvinea	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Rhodymenia240	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Rhodymenia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Rhodyleptophylla	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Epymenia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Cordylecladia	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Bwynnei218	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
B.wynnei	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Bleptopoda	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Bebriosa	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Bsonderi	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
B.occidentalis	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.wrightii	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.wrightii	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.enteromorpha201	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
C.enteromorpha143	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Halymenia	TTAGAGTGTTCAAAGCAGGCGTTTGCCCTGAATACATTAGCATGGAATAA
Sebdenia	TTAGAGTGTTCAAAGCAGGCGTTTGCCATGAATACATTAGCATGGAATAA
Fryeella	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Hymenocladiopsis	TTAGAGTGTTCAAAGCAGGCGTTTGCCGTGAATACATTAGCATGGAATAA
Lomentaria183	TTAGAGTGTTCAAAGCAGGCAATTGCCGTGAATACATTAGCATGGAATAA
Lomentaria145	TTAGAGTGTTCAAAGCAGGCAATTGCCGTGAATACATTAGCATGGAATAA
Lombaileyana	TTAGAGTGTTCAAAGCAGGCAATTGCCGTGAATACATTAGCATGGAATAA
Lomaustralis	TTAGAGTGTTCAAAGCAGGCAATTGCCGTGAATACATTAGCATGGAATAA
Ceraintricat	TTAGAGTGTTCAAAGCAGGCAATGGCCGTGAATACATTAGCATGGAATAA
Ceratodict	TTAGAGTGTTCAAAGCAGGCAATGGCCGTGAATACATTAGCATGGAATAA
Ceratodictyon	TTAGAGTGTTCAAAGCAGGCAATGGCCGTGAATACATTAGCATGGAATAA
Semnocarpa	TTAGAGTGTTCAAAGCAGGCAATTGCCGTGAATACATTAGCATGGAATAA
Gloioderma	TTAGAGTGTTCAAAGCAGGCAAGTGCCGTGAATACATTAGCATGGAATAA
Gloiocladi163	TTAGAGTGTTCAAAGCAGGCAAGTGCCGTGAATACATTAGCATGGAATAA
G.furcata	TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA

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Glaciniata          TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA
Grepens             TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA
Gloirepens          TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA
Faucheopsis         TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA
Webervanbossea      TTAGAGTGTTCAAAGCAGGCATTTGCCGTGAATACATTAGCATGGAATAA
                     ************* *****    *** ******** ******** ****


Chy.verticillata    TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTATAATCGGGTAATG
Gastroclonium       TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTATAATCGGGTAATG
Chy.schneideri      TAGAATAGTACCTGGTTTCTATTTTGTTGGTGTGTTAGGATGAGGTAATG
C.irregularis202    TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.irregularis203    TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Coelothrix171       TAAAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.harveyana177      TAGAATAGGACCTGGTCTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.harveyana160      TAGAATAGGACCTGGTCTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Chharv194           TAGAATAGGACCTGGTCTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Ch.parvula173       TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.parvula198        TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Ch.sali195          TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.sali161           TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Champia214          TAGAATAGGACCTGGTCTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Champia214a         TAGAATAGGACCTGGTCTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.vieillardii       TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Chviellar221        TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.vieillardii286    TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Ch.affinis          TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Dictyothamnion      TAGAATAGGACTTGTTTTCTATTTTGTTGGTTTGTTAGAAACAGGTAATG
Hymenocladia        TAGAATAGGACCTGAGC-CTATTTTGTTGGTTTGTTAGTTTCGGGTAATG
Erythrymenia        TAGAATAGGACCTGAAC-CTATTTTGTTGGTTTGTTAGTTTCGGGTAATG
Abermudensis        TAGAATAGGACCTGGAC-CTATTTTGTTGGTTTGTTAGGCTCGGGTAATG
Apeltata            TAGAATAGGACCTGGAC-CTATTTTGTTGGTTTGTTAGGCTCGGGTAATG
Asteranastomosans   TAGAATAGGACCTGGAC-CTATTTTGTTGGTTTGTTAGGCTCGGGTAATG
Ch.nodulosa         TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.agardhii          TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Gloiosaccion        TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Chornata            TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Maripelta           TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Drouetia            TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTGAGGATCGGGTAATG
Coelarthrum236      TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
C.clifton235        TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
C.cliftonii         TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
New genus           TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
New genus           TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Erythrocolon        TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Coelaopuntia        TAGAATAGGACCTGGTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Chamaebotrys231     TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Chamaebotrys232     TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Halichrysis         TAGAATAGGACCTGGCTTCTATTTTGTTGGTTTGTTAGTACCGGGTAATG
Hmicans             TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGTACTGGGTAATG
B.iridescens        TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
B.irri              TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
B.spinulifera       TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Bspinulifera144     TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Leptosomia          TAGAATAGGACCTGTGTACTATTTTGTTGGTTTGTTAGGCTCAGGTAATG
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Cephaleucobotrys    TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Cephafurcellata     TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Sparlingia          TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Irvinea             TAGAATAGGACCTGGTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Rhodymenia240       TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Rhodymenia          TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Rhodyleptophylla    TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Epymenia            TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Cordylecladia       TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Bwynnei218          TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
B.wynnei            TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Bleptopoda          TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Bebriosa            TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Bsonderi            TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
B.occidentalis      TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
C.wrightii          TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
C.wrightii          TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
C.enteromorpha201   TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
C.enteromorpha143   TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Halymenia           TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Sebdenia            TAGAATAGGACCTGTTTCCTATTTTGTTGGTTTGTTAGGATCGGGTAATG
Fryeella            TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Hymenocladiopsis    TAGAATAGGACCTGTTTTCTATTTTGTTGGTTTGTGAGAATCGGGTAATG
Lomentaria183       TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Lomentaria145       TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Lombaileyana        TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Lomaustralis        TAGAATAGGACCTGTCTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Ceraintricat        TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Ceratodict          TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Ceratodictyon       TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Semnocarpa          TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
Gloioderma          TAGAATAGGACCTGTGTTTTATTTTGTTGGTTTGTTAGAGCCGGGTAATG
Gloiocladi163       TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAGCCGGGTAATG
G.furcata           TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Glaciniata          TAGAATAGGACCTGTGTTTTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Grepens             TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Gloirepens          TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Faucheopsis         TAGAATAGGACCTGTGTTCTATTTTGTTGGTTTGTTAGAATCGGGTAATG
Webervanbossea      TAGAATAGGACCTGGCTTCTATTTTGTTGGTTTGTTAGAAACGGGTAATG
                    ** ***** ** **     ************ *** *      *******

Chy.verticillata    ATTAAGAGGGATGGTTGGGGGCATTTATATTCCAGCGCTAGAGGTGAAAT
Gastroclonium       ATTAAGAGGGATGGTTGGGGGCATTTATATTCCAGCGCTAGAGGTGAAAT
Chy.schneideri      ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTTAGAGGTGAAAT
C.irregularis202    ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.irregularis203    ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Coelothrix171       ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.harveyana177      ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.harveyana160      ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Chharv194           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Ch.parvula173       ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.parvula198        ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Ch.sali195          ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.sali161           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
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Champia214	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Champia214a	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.vieillardii	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Chviellar221	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.vieillardii286	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Ch.affinis	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Dictyothamnion	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Hymenocladia	ATTAAGAGGGATGGTTGGGGCCATTTGTATTCTAGCGTCAGAGGTGAAAT
Erythrymenia	ATTAAGAGGGATGGTTGGGGCCATTTGTATTCTAGCGTCAGAGGTGAAAT
Abermudensis	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCTAGCGTCAGAGGTGAAAT
Apeltata	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCTAGCGTCAGAGGTGAAAT
Asteranastomosans	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCTAGCGTCAGAGGTGAAAT
Ch.nodulosa	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.agardhii	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Gloiosaccion	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Chornata	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Maripelta	ATTAAGAGGGATGGTTGGGGGCATTTGTATTTCAGCGTCAGAGGTGAAAT
Drouetia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Coelarthrum236	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.clifton235	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.cliftonii	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
New genus	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
New genus	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Erythrocolon	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Coelaopuntia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Chamaebotrys231	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Chamaebotrys232	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Halichrysis	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Hmicans	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
B.iridescens	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
B.irri	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
B.spinulifera	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Bspinulifera144	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Leptosomia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Cephaleucobotrys	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Cephafurcellata	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Sparlingia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Irvinea	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Rhodymenia240	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Rhodymenia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Rhodyleptophylla	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Epymenia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Cordylecladia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Bwynnei218	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
B.wynnei	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Bleptopoda	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Bebriosa	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Bsonderi	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
B.occidentalis	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.wrightii	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.wrightii	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.enteromorpha201	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
C.enteromorpha143	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Halymenia	ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT

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Sebdenia             ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGTCAGAGGTGAAAT
Fryeella             ATTAAGAGGGATGGTTGGGGGCATTTGTATTCTAGCGTCAGAGGTGAAAT
Hymenocladiopsis     ATTAAGAGGGATGGTTGGGGGCATTTGTATTCTAGCGTCAGAGGTGAAAT
Lomentaria183        ATTAAGAGGGATGGTCGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Lomentaria145        ATTAAGAGGGATGGTCGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Lombaileyana         ATTAAGAGGGATGGTCGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Lomaustralis         ATTAAGAGGGATGGTCGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Ceraintricat         ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Ceratodict           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Ceratodictyon        ATTAAGAGGGATGGTTGGGGGCATTTGTATTTCAGCGCTAGAGGTGAAAT
Semnocarpa           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Gloioderma           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Gloiocladi163        ATTAAGAGGGATGGTTGGGGGCATCTGTATTCCAGCGCTAGAGGTGAAAT
G.furcata            ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Glaciniata           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Grepens              ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Gloirepens           ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Faucheopsis          ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
Webervanbossea       ATTAAGAGGGATGGTTGGGGGCATTTGTATTCCAGCGCTAGAGGTGAAAT
                     *************** **** *** * ****  ****  ***********

Chy.verticillata     TCTTGGATTGTTGGAAGATAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Gastroclonium        TCTTGGATTGTTGGAAGATAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chy.schneideri       TTTTGGATTGGTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.irregularis202     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAAGACAT
C.irregularis203     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Coelothrix171        TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.harveyana177       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.harveyana160       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chharv194            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Ch.parvula173        CTTTGGATTGTTGGAAGACAAACAGCTGCGCGAGCGTCTGCCAAGGACAT
C.parvula198         CTTTGGATTGTTGGAAGACAAACAACTGCGCGAGCGTCTGCCAAGGACAT
Ch.sali195           TCTTGAGTTATTGGAAGACAAACAACCGCGCGAGCGTCTGCCAAGGACAT
C.sali161            TCTTGAGTTATTGGAAGACAAACAACCGCGCGAGCGTCTGCCAAGGACAT
Champia214           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Champia214a          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.vieillardii        TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chviellar221         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.vieillardii286     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Ch.affinis           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Dictyothamnion       TCTTGGATTGCTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Hymenocladia         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGGCAAGGACGT
Erythrymenia         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGGCAAGGACAT
Abermudensis         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCATGGACAT
Apeltata             TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCATGGACAT
Asteranastomosans    TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCATGGACAT
Ch.nodulosa          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.agardhii           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Gloiosaccion         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chornata             TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Maripelta            TCTTGGATTGTTGAAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Drouetia             TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Coelarthrum236       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.clifton235         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
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C.cliftonii         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
New genus           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
New genus           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Erythrocolon        TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Coelaopuntia        TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chamaebotrys231     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Chamaebotrys232     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Halichrysis         TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Hmicans             TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
B.iridescens        TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
B.irri              TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
B.spinulifera       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Bspinulifera144     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Leptosomia          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Cephaleucobotrys    TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Cephafurcellata     TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Sparlingia          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Irvinea             TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Rhodymenia240       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Rhodymenia          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Rhodyleptophylla    TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Epymenia            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Cordylecladia       TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Bwynnei218          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
B.wynnei            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Bleptopoda          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Bebriosa            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Bsonderi            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
B.occidentalis      TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.wrightii          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.wrightii          TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.enteromorpha201   TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
C.enteromorpha143   TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Halymenia           TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Sebdenia            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Fryeella            TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Hymenocladiopsis    TCTTGGATTGTTGGAAGACAAACAGCTGCGAAAGCGTCTGCCAAGGACAT
Lomentaria183       TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Lomentaria145       TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Lombaileyana        TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Lomaustralis        TCTTGGATTGTTGGAAGACACACTGCTGCGAAAGCGTCTGCCAAGGACAT
Ceraintricat        TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Ceratodict          TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Ceratodictyon       TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Semnocarpa          TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Gloioderma          TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Gloiocladi163       TCGTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
G.furcata           TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Glaciniata          TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Grepens             TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Gloirepens          TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Faucheopsis         TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
Webervanbossea      TCTTGGATTGTTGGAAGACAAACTGCTGCGAAAGCGTCTGCCAAGGACAT
                       **  **  ** **** * **  * ***  ******** **  *** *
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Chy.verticillata    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Gastroclonium       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chy.schneideri      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.irregularis202    TTTCATTGATCAAGAACGAAAGTCAGGGGATCGAAGACGATCAGATACCG
C.irregularis203    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAAATACCG
Coelothrix171       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.harveyana177      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.harveyana160      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chharv194           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ch.parvula173       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.parvula198        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ch.sali195          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.sali161           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Champia214          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Champia214a         TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.vieillardii       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chviellar221        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.vieillardii286    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ch.affinis          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Dictyothamnion      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Hymenocladia        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Erythrymenia        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Abermudensis        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Apeltata            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Asteranastomosans   TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ch.nodulosa         TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.agardhii          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Gloiosaccion        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chornata            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Maripelta           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Drouetia            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Coelarthrum236      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.clifton235        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.cliftonii         TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
New genus           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
New genus           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Erythrocolon        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Coelaopuntia        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chamaebotrys231     TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Chamaebotrys232     TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Halichrysis         TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Hmicans             TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
B.iridescens        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
B.irri              TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
B.spinulifera       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Bspinulifera144     TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Leptosomia          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Cephaleucobotrys    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Cephafurcellata     TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Sparlingia          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Irvinea             TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Rhodymenia240       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Rhodymenia          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
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Rhodyleptophylla    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Epymenia            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Cordylecladia       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Bwynnei218          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
B.wynnei            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Bleptopoda          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Bebriosa            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Bsonderi            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
B.occidentalis      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.wrightii          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.wrightii          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.enteromorpha201   TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
C.enteromorpha143   TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Halymenia           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Sebdenia            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Fryeella            TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Hymenocladiopsis    TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Lomentaria183       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Lomentaria145       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Lombaileyana        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Lomaustralis        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ceraintricat        TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ceratodict          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Ceratodictyon       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Semnocarpa          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Gloioderma          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Gloiocladi163       TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
G.furcata           TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Glaciniata          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Grepens             TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Gloirepens          TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Faucheopsis         TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
Webervanbossea      TTTCATTGATCAAGAACGAAAGTAAGGGGATCGAAGACGATCAGATACCG
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Chy.verticillata    TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGCGGAACTATT
Gastroclonium       TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGAACTATT
Chy.schneideri      TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGATGGAAATATT
C.irregularis202    TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGAAATATT
C.irregularis203    TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGAAATATT
Coelothrix171       TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGAAATATT
C.harveyana177      TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
C.harveyana160      TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
Chharv194           TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
Ch.parvula173       TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
C.parvula198        TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
Ch.sali195          TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
C.sali161           TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATATT
Champia214          TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATAAT
Champia214a         TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATAAA
C.vieillardii       TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATAAT
Chviellar221        TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATAAT
C.vieillardii286    TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATAAT
Ch.affinis          TCGTAGTCTTTACTATAAACTATGAGGACTGGAGATCGGGTGGGAATACT
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Dictyothamnion	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGACCGTT
Hymenocladia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGTCAGTGCTGAT
Erythrymenia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGACTGAT
Abermudensis	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTG--
Apeltata	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTG--
Asteranastomosans	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTG--
Ch.nodulosa	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.agardhii	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Gloiosaccion	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Chornata	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Maripelta	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTG-C
Drouetia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Coelarthrum236	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.clifton235	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.cliftonii	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
New genus	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
New genus	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Erythrocolon	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGACTGTC
Coelaopuntia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Chamaebotrys231	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Chamaebotrys232	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Halichrysis	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTA
Hmicans	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTT
B.iridescens	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
B.irri	TCGTAGTCTTTACTATAAACGATGAAAACTGGAGATCGGGCGGGGCTGTC
B.spinulifera	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Bspinulifera144	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Leptosomia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Cephaleucobotrys	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Cephafurcellata	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Sparlingia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Irvinea	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Rhodymenia240	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Rhodymenia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Rhodyleptophylla	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Epymenia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Cordylecladia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Bwynnei218	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
B.wynnei	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Bleptopoda	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Bebriosa	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Bsonderi	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
B.occidentalis	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.wrightii	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.wrightii	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.enteromorpha201	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
C.enteromorpha143	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTC
Halymenia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTT
Sebdenia	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTT
Fryeella	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTT
Hymenocladiopsis	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGTT
Lomentaria183	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Lomentaria145	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Lombaileyana	TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTTT-

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Lomaustralis        TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Ceraintricat        TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Ceratodict          TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Ceratodictyon       TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGGCGGGGCTGT-
Semnocarpa          TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Gloioderma          TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Gloiocladi163       TCGTAGTCTTTACTATCGACGATGAGGACTGGAGATCGGACGGGGCTGT-
G.furcata           TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Glaciniata          TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Grepens             TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Gloirepens          TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Faucheopsis         TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
Webervanbossea      TCGTAGTCTTTACTATAAACGATGAGGACTGGAGATCGGACGGGGCTGT-
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Chy.verticillata    ATATGGTCTGCCCGGCACCCTTCGGGAAACCAAAGTATTTGCTTTCTGGG
Gastroclonium       ATATGGTCCGCCCGGCACCCTTCGGGAAACCAAAGTATTTGCTTTCTGGG
Chy.schneideri      ATATGGTCCGTCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.irregularis202    ATATGGTCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.irregularis203    ATATGGTCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Coelothrix171       ATATGGTCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.harveyana177      TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.harveyana160      TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Chharv194           TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ch.parvula173       TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTCCTGGG
C.parvula198        TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTCCTGGG
Ch.sali195          TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.sali161           TTATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Champia214          ACATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Champia214a         ACATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.vieillardii       ACATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Chviellar221        ACATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.vieillardii286    ACATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ch.affinis          ATATGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Dictyothamnion      ATTTGGCTCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Hymenocladia        TAGGGGCCTGACCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Erythrymenia        ATCTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Abermudensis        CTCTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Apeltata            CTCTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Asteranastomosans   CTCTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ch.nodulosa         ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.agardhii          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Gloiosaccion        ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Chornata            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Maripelta           ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Drouetia            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Coelarthrum236      ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.clifton235        ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.cliftonii         ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
New genus           ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
New genus           ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Erythrocolon        ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Coelaopuntia        ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Chamaebotrys231     ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
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Chamaebotrys232     ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Halichrysis         TTTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Hmicans             ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
B.iridescens        ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
B.irri              ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
B.spinulifera       ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Bspinulifera144     ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Leptosomia          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Cephaleucobotrys    ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Cephafurcellata     ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Sparlingia          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Irvinea             ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Rhodymenia240       ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Rhodymenia          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Rhodyleptophylla    ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Epymenia            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Cordylecladia       ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Bwynnei218          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
B.wynnei            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Bleptopoda          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Bebriosa            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Bsonderi            ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
B.occidentalis      ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.wrightii          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.wrightii          ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.enteromorpha201   ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
C.enteromorpha143   ATTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Halymenia           -TTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Sebdenia            -TTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Fryeella            -TTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Hymenocladiopsis    -TTTGGCCCGCCCGGCATCCTTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Lomentaria183       TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Lomentaria145       TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Lombaileyana        ATTTGGCCCGCTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Lomaustralis        TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ceraintricat        TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ceratodict          TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Ceratodictyon       TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Semnocarpa          TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Gloioderma          TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Gloiocladi163       TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
G.furcata           TTTTGGCCCGTTCGGCATCCCTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Glaciniata          TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Grepens             TTTTGGCCCGTTCGGCATCCCTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Gloirepens          TTTTGGCCCGTTCGGCATCCCTCGGGAAACCAAAGTGTTTGCTTTCTGGG
Faucheopsis         TTTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
Webervanbossea      ACTTGGCCCGTTCGGCATCCCCCGGGAAACCAAAGTGTTTGCTTTCTGGG
                        **   *  ***** **  ************** ******* *****

Chy.verticillata    GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Gastroclonium       GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chy.schneideri      GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.irregularis202    GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.irregularis203    GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
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Coelothrix171	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.harveyana177	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.harveyana160	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chharv194	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ch.parvula173	GGGAGTATGACCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.parvula198	GGGAGTATGACCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ch.sali195	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.sali161	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Champia214	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Champia214a	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.vieillardii	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chviellar221	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.vieillardii286	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ch.affinis	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Dictyothamnion	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Hymenocladia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Erythrymenia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Abermudensis	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Apeltata	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Asteranastomosans	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ch.nodulosa	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.agardhii	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Gloiosaccion	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chornata	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Maripelta	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Drouetia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Coelarthrum236	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.clifton235	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.cliftonii	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
New genus	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
New genus	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Erythrocolon	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Coelaopuntia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chamaebotrys231	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Chamaebotrys232	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Halichrysis	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Hmicans	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
B.iridescens	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
B.irri	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
B.spinulifera	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Bspinulifera144	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Leptosomia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Cephaleucobotrys	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Cephafurcellata	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Sparlingia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Irvinea	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Rhodymenia240	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Rhodymenia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Rhodyleptophylla	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Epymenia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Cordylecladia	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Bwynnei218	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
B.wynnei	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Bleptopoda	GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC

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Bebriosa              GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Bsonderi              GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
B.occidentalis        GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.wrightii            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.wrightii            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.enteromorpha201     GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
C.enteromorpha143     GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Halymenia             GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Sebdenia              GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Fryeella              GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Hymenocladiopsis      GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Lomentaria183         GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Lomentaria145         GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Lombaileyana          GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Lomaustralis          GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ceraintricat          GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ceratodict            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Ceratodictyon         GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Semnocarpa            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Gloioderma            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Gloiocladi163         GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
G.furcata             GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Glaciniata            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Grepens               GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Gloirepens            GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Faucheopsis           GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
Webervanbossea        GGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGGAGGGCATC
                      *********  ***************************************

Chy.verticillata      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Gastroclonium         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chy.schneideri        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.irregularis202      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.irregularis203      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Coelothrix171         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.harveyana177        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.harveyana160        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chharv194             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ch.parvula173         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.parvula198          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ch.sali195            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.sali161             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Champia214            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Champia214a           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.vieillardii         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chviellar221          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.vieillardii286      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ch.affinis            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Dictyothamnion        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Hymenocladia          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Erythrymenia          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Abermudensis          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Apeltata              ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Asteranastomosans     ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
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Ch.nodulosa          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.agardhii           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Gloiosaccion         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chornata             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Maripelta            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Drouetia             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Coelarthrum236       ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.clifton235         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.cliftonii          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
New genus            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
New genus            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Erythrocolon         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Coelaopuntia         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chamaebotrys231      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Chamaebotrys232      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Halichrysis          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Hmicans              ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
B.iridescens         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
B.irri               ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTAAC
B.spinulifera        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Bspinulifera144      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Leptosomia           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Cephaleucobotrys     ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Cephafurcellata      ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Sparlingia           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Irvinea              ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Rhodymenia240        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Rhodymenia           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Rhodyleptophylla     ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Epymenia             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Cordylecladia        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Bwynnei218           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
B.wynnei             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Bleptopoda           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Bebriosa             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Bsonderi             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
B.occidentalis       ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.wrightii           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.wrightii           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.enteromorpha201    ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
C.enteromorpha143    ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Halymenia            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Sebdenia             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Fryeella             ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Hymenocladiopsis     ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Lomentaria183        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Lomentaria145        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Lombaileyana         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Lomaustralis         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ceraintricat         ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ceratodict           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Ceratodictyon        ACTGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Semnocarpa           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTAC
Gloioderma           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
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Gloiocladi163        ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
G.furcata            ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Glaciniata           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Grepens              ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Gloirepens           ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Faucheopsis          ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
Webervanbossea       ACCGGGTGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGAAAACTTAC
                     ** ************************************** ***** **

Chy.verticillata     CAGGTCAGGACATAATAAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Gastroclonium        CAGGTCAGGACATAATAAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chy.schneideri       CAGGTCAGGACATATTAAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.irregularis202     CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.irregularis203     CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Coelothrix171        CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.harveyana177       CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.harveyana160       CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chharv194            CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ch.parvula173        CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.parvula198         CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ch.sali195           CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.sali161            CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Champia214           CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Champia214a          CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.vieillardii        CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chviellar221         CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.vieillardii286     CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ch.affinis           CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Dictyothamnion       CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Hymenocladia         CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Erythrymenia         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Abermudensis         CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Apeltata             CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Asteranastomosans    CAGGTCAGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ch.nodulosa          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.agardhii           CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Gloiosaccion         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chornata             CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Maripelta            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Drouetia             CAGGTCCGGACATAGTAAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Coelarthrum236       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.clifton235         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.cliftonii          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
New genus            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
New genus            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Erythrocolon         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Coelaopuntia         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chamaebotrys231      CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Chamaebotrys232      CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Halichrysis          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Hmicans              CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
B.iridescens         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
B.irri               CAGGTCCGGACATAGTGAGGATTAACCGATTGAGAGCTCTTTCTTGATTC
B.spinulifera        CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
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Bspinulifera144     CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Leptosomia          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Cephaleucobotrys    CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Cephafurcellata     CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Sparlingia          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Irvinea             CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Rhodymenia240       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Rhodymenia          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Rhodyleptophylla    CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Epymenia            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Cordylecladia       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Bwynnei218          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
B.wynnei            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Bleptopoda          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Bebriosa            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Bsonderi            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
B.occidentalis      CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.wrightii          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.wrightii          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.enteromorpha201   CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
C.enteromorpha143   CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Halymenia           CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Sebdenia            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Fryeella            CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Hymenocladiopsis    CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Lomentaria183       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Lomentaria145       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Lombaileyana        CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Lomaustralis        CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ceraintricat        CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ceratodict          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Ceratodictyon       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Semnocarpa          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Gloioderma          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Gloiocladi163       CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
G.furcata           CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Glaciniata          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Grepens             CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Gloirepens          CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Faucheopsis         CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
Webervanbossea      CAGGTCCGGACATAGTGAGGATTGACAGATTGAGAGCTCTTTCTTGATTC
                    ****** ******* * ****** ** ***********************

Chy.verticillata    TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Gastroclonium       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chy.schneideri      TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.irregularis202    TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.irregularis203    TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Coelothrix171       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.harveyana177      TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.harveyana160      TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chharv194           TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Ch.parvula173       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.parvula198        TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
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Ch.sali195	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.sali161	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Champia214	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Champia214a	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.vieillardii	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chviellar221	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.vieillardii286	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Ch.affinis	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Dictyothamnion	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Hymenocladia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Erythrymenia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Abermudensis	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Apeltata	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Asteranastomosans	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Ch.nodulosa	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.agardhii	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Gloiosaccion	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chornata	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Maripelta	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Drouetia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Coelarthrum236	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.clifton235	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.cliftonii	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
New genus	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
New genus	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Erythrocolon	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Coelaopuntia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chamaebotrys231	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Chamaebotrys232	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Halichrysis	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Hmicans	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
B.iridescens	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
B.irri	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
B.spinulifera	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Bspinulifera144	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Leptosomia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Cephaleucobotrys	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Cephafurcellata	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Sparlingia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Irvinea	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Rhodymenia240	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Rhodymenia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Rhodyleptophylla	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Epymenia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Cordylecladia	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Bwynnei218	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
B.wynnei	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Bleptopoda	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Bebriosa	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Bsonderi	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
B.occidentalis	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.wrightii	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.wrightii	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
C.enteromorpha201	TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG

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C.enteromorpha143   TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Halymenia           TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Sebdenia            TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Fryeella            TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Hymenocladiopsis    TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATCTGTCTGG
Lomentaria183       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Lomentaria145       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Lombaileyana        TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Lomaustralis        TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Ceraintricat        TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Ceratodict          TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Ceratodictyon       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTAGTCTGTCTGG
Semnocarpa          TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Gloioderma          TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Gloiocladi163       TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
G.furcata           TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Glaciniata          TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Grepens             TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Gloirepens          TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Faucheopsis         TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
Webervanbossea      TATGGTTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGGTCTGTCTGG
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Chy.verticillata    TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Gastroclonium       TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Chy.schneideri      TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCACCATTAC
C.irregularis202    TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCACTAC
C.irregularis203    TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCACTAC
Coelothrix171       TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCACTAC
C.harveyana177      TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
C.harveyana160      TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Chharv194           TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Ch.parvula173       TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
C.parvula198        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Ch.sali195          TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
C.sali161           TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTACTAC
Champia214          TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGAGTAC
Champia214a         TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGAGTAC
C.vieillardii       TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGAGTAC
Chviellar221        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGAGTAC
C.vieillardii286    TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGAGTAC
Ch.affinis          TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCTAGTAC
Dictyothamnion      TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Hymenocladia        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGATACTTGTAT
Erythrymenia        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGATGCTTGTAT
Abermudensis        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGATGCTCCTAT
Apeltata            TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGATGCTCCTAT
Asteranastomosans   TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGATGCTCCTAT
Ch.nodulosa         TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.agardhii          TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Gloiosaccion        TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Chornata            TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Maripelta           TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Drouetia            TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
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Coelarthrum236	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.clifton235	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.cliftonii	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
New genus	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
New genus	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Erythrocolon	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Coelaopuntia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Chamaebotrys231	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Chamaebotrys232	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Halichrysis	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Hmicans	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
B.iridescens	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
B.irri	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
B.spinulifera	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Bspinulifera144	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Leptosomia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Cephaleucobotrys	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGATTAC
Cephafurcellata	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCGATTAC
Sparlingia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Irvinea	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Rhodymenia240	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Rhodymenia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Rhodyleptophylla	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Epymenia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Cordylecladia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Bwynnei218	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
B.wynnei	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Bleptopoda	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Bebriosa	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Bsonderi	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
B.occidentalis	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.wrightii	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.wrightii	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.enteromorpha201	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
C.enteromorpha143	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Halymenia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Sebdenia	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Fryeella	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Hymenocladiopsis	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGCGCCATTAC
Lomentaria183	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATCATTAC
Lomentaria145	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATCATTAC
Lombaileyana	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATCATTAC
Lomaustralis	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATCATTAC
Ceraintricat	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATGACTAC
Ceratodict	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATGACTAC
Ceratodictyon	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATCACTAC
Semnocarpa	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGAAATTGTTAC
Gloioderma	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCGTTAC
Gloiocladi163	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCGTTAC
G.furcata	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCATTAC
Glaciniata	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCATTAC
Grepens	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCATTAC
Gloirepens	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCATTAC
Faucheopsis	TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGCTAGGTTCCATTAC

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Webervanbossea      TTAATTCCGTTAACGAGCGAGACCTGGGCGTGTTAGATAGGCTCCATTAC
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Chy.verticillata    CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Gastroclonium       CCCTTT-TGGTAGTGAGG-TGGCCTTCCTAAACGGACTGCGGACGTCTAG
Chy.schneideri      CCTTTT-TGGTAGTGTAGTTTGCCTTCCTAAACGGACTGCGGACGTCTAG
C.irregularis202    CCCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGACGTCTAG
C.irregularis203    CCCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGACGTCTAG
Coelothrix171       CCCTTT-TGGTAGTGAGGCTAGCTTTCCTAAACGGACTGCGGACGTCTAG
C.harveyana177      CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
C.harveyana160      CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Chharv194           CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Ch.parvula173       CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
C.parvula198        CCTTTT-TGGTAGTGACGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Ch.sali195          CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
C.sali161           CCTTTT-TGGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Champia214          TGCTTT-TGGTACTAACGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
Champia214a         TGCTTT-TGGTACTAACGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
C.vieillardii       TGCTTT-TGGTACTAACGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
Chviellar221        TGCTTT-TGGTACTAACGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
C.vieillardii286    TGCTTT-TGGTACTAACGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
Ch.affinis          CGCTTT-TGGTACTAAGGCTTGCCTTCCTAAACGGACTGCGGACGTCTAG
Dictyothamnion      ACCTTT-TCGTAGTGAGGCTGGCCTTCCTAAACGGACTGCGGACGTCTAG
Hymenocladia        CGCTTT-TGATACTTG---TAATCTTCCTAAACGGACTGCGGGCATCTAG
Erythrymenia        CGCTTT-TGATACTCG---TAATCTTCCTAAACGGACTGCGGGCATCTAG
Abermudensis        CTTTTA-TGATAGTTG---TGATCTTCCTAAACGGACTGCGGGCATCTAG
Apeltata            CTTTTA-TGATAGTTG---TGATCTTCCTAAACGGACTGCGGGCATCTAG
Asteranastomosans   CTTTTA-TGATAGTTG---TGATCTTCCTAAACGGACTGCGGGCATCTAG
Ch.nodulosa         CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.agardhii          CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Gloiosaccion        CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Chornata            CGATTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Maripelta           CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Drouetia            CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Coelarthrum236      CGCTTA-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.clifton235        CGCTTA-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.cliftonii         CGCTTA-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
New genus           CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
New genus           CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Erythrocolon        CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Coelaopuntia        CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Chamaebotrys231     CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Chamaebotrys232     CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Halichrysis         CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Hmicans             CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
B.iridescens        CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
B.irri              CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
B.spinulifera       CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Bspinulifera144     CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Leptosomia          CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Cephaleucobotrys    CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Cephafurcellata     CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Sparlingia          CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Irvinea             CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
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Rhodymenia240       CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Rhodymenia          CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Rhodyleptophylla    CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Epymenia            CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Cordylecladia       CGCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Bwynnei218          CCCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
B.wynnei            CCCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Bleptopoda          CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Bebriosa            CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Bsonderi            CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
B.occidentalis      CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.wrightii          CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.wrightii          CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.enteromorpha201   CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
C.enteromorpha143   CCTTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Halymenia           CCCTTT-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Sebdenia            CGCTTA-TGGTAGTGAGGCTAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Fryeella            CGCTTT-TGGTAGTGAGG-TAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Hymenocladiopsis    CGCTTT-TGGTAGTGAGG-TAGCCTTCCTAAACGGACTGCGGGCGTCTAG
Lomentaria183       -ACTTTGTGGTAGTGAGA-TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Lomentaria145       -ACTTTGTGGTAGTGAGA-TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Lombaileyana        -ACTTTGTGGTAGTGA---TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Lomaustralis        -ACTTTGTGGTAGTGA---TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Ceraintricat        -ACTTTGTGGTAGTGA---TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Ceratodict          -ACTTTGTGGTAGTGA---TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Ceratodictyon       -ACTTTGCGGTAGTGA--TCCTTCTTCCTAAACGGACTGCGGCCATGTAG
Semnocarpa          TACTTTTTGGTAGCGA---TCTTCTTCCTAAACGGACTGCGGCCGTCTAG
Gloioderma          CGCTTT-TGGTAGCG-TAGATGCCTTCCTAAACGGACTGCGGCCGTCTAG
Gloiocladi163       CGCTTT-TGGTAGCG-CAGATACCTTCCTAAACGGACTGCGGCCGTCTAG
G.furcata           CGCTTT-TGGTAGTG-TAGATGCCTTCCTAAACGGACTGCGGCTGTCTAA
Glaciniata          CGCTTT-TGGTAGTG-TAGATGCCTTCCTAAACGGACTGCGGCTGTCTAA
Grepens             CGCTTT-TGGTAGTG-TAGATGCCTTCCTAAACGGACTGCGGCTGTCTAA
Gloirepens          CGATTT-TGGTAGTG-TAGATGCCTTCCTAAACGGACTGCGGCTGTCTAA
Faucheopsis         CGTCTT-TGGTAGTG-TAGATGCCTTCCTAAACGGACTGCGGCCGTCTAG
Webervanbossea      C-TTTT-TGGTAGTGCTAGATGCCTTCCTAAACGGACTGCGGCTGTCTAA
                        *     **            ******************   * **

Chy.verticillata    TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Gastroclonium       TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chy.schneideri      TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.irregularis202    TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.irregularis203    TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Coelothrix171       TCCGCGGAAGCTCCAGGCAATTACAGGTCTGAGATGCCCTTAGATGTTCT
C.harveyana177      TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.harveyana160      TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chharv194           TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ch.parvula173       TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.parvula198        TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ch.sali195          TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.sali161           TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Champia214          TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Champia214a         TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.vieillardii       TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chviellar221        TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
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C.vieillardii286	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ch.affinis	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Dictyothamnion	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Hymenocladia	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Erythrymenia	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Abermudensis	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Apeltata	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Asteranastomosans	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ch.nodulosa	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.agardhii	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Gloiosaccion	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chornata	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Maripelta	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Drouetia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Coelarthrum236	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.clifton235	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.cliftonii	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
New genus	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
New genus	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Erythrocolon	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Coelaopuntia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chamaebotrys231	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Chamaebotrys232	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Halichrysis	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Hmicans	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
B.iridescens	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
B.irri	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
B.spinulifera	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Bspinulifera144	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Leptosomia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Cephaleucobotrys	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Cephafurcellata	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Sparlingia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Irvinea	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Rhodymenia240	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Rhodymenia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Rhodyleptophylla	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Epymenia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Cordylecladia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Bwynnei218	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
B.wynnei	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Bleptopoda	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Bebriosa	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Bsonderi	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
B.occidentalis	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.wrightii	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.wrightii	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.enteromorpha201	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
C.enteromorpha143	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Halymenia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Sebdenia	CCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Fryeella	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Hymenocladiopsis	TCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Lomentaria183	GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT

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Lomentaria145       GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Lombaileyana        GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Lomaustralis        GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ceraintricat        GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ceratodict          GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Ceratodictyon       GCCGCGGAAGCTCTAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Semnocarpa          GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Gloioderma          GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Gloiocladi163       GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
G.furcata           GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Glaciniata          GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Grepens             GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Gloirepens          GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Faucheopsis         GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
Webervanbossea      GCCGCGGAAGCTCCAGGCAATAACAGGTCTGAGATGCCCTTAGATGTTCT
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Chy.verticillata    GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGTGGTGCGAA
Gastroclonium       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGTTGTGCGAA
Chy.schneideri      GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGTTGTGCGAA
C.irregularis202    GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
C.irregularis203    GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
Coelothrix171       GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
C.harveyana177      GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGGA
C.harveyana160      GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGGA
Chharv194           GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
Ch.parvula173       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGTGCGAA
C.parvula198        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGTTGTGCGAA
Ch.sali195          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
C.sali161           GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
Champia214          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGTTATGCGAA
Champia214a         GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGTTATGCGAA
C.vieillardii       GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGTTATGCGGA
Chviellar221        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
C.vieillardii286    GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
Ch.affinis          GGGCCGCACGCGTGCAACACTGAGCGGGTCAACGGGTGAGGATGTACGGA
Dictyothamnion      GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAA
Hymenocladia        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGTGCGAG
Erythrymenia        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATATGCGAG
Abermudensis        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Apeltata            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Asteranastomosans   GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATATGCGAG
Ch.nodulosa         GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGCGAGGATATGCGAA
C.agardhii          GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGCGAGGATATGCGAA
Gloiosaccion        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTCAGGATATGCGAA
Chornata            GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATATGCGAA
Maripelta           GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Drouetia            GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGGGAGGATATGCGAG
Coelarthrum236      GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
C.clifton235        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
C.cliftonii         GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
New genus           GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
New genus           GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Erythrocolon        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
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Coelaopuntia        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Chamaebotrys231     GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Chamaebotrys232     GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Halichrysis         GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Hmicans             GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
B.iridescens        GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
B.irri              GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
B.spinulifera       GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Bspinulifera144     GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Leptosomia          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Cephaleucobotrys    GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATATGCGAG
Cephafurcellata     GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATATGCGAG
Sparlingia          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Irvinea             GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Rhodymenia240       GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAG
Rhodymenia          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGCGAGGATGTGCGAG
Rhodyleptophylla    GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGCGAGGATGTGCGAG
Epymenia            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGCGAGGATGTGCGAG
Cordylecladia       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGTGCGAG
Bwynnei218          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAG
B.wynnei            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Bleptopoda          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTTAGGATATGCGAG
Bebriosa            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTTAGGATATGCGAG
Bsonderi            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTAAGGATATGCGAG
B.occidentalis      GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
C.wrightii          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGCGAGGATATGCGAG
C.wrightii          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGCGAGGATATGCGAG
C.enteromorpha201   GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
C.enteromorpha143   GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAG
Halymenia           GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAG
Sebdenia            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGTGCGAG
Fryeella            GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAA
Hymenocladiopsis    GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATATGCGAA
Lomentaria183       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Lomentaria145       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Lombaileyana        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Lomaustralis        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Ceraintricat        GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Ceratodict          GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Ceratodictyon       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Semnocarpa          GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
Gloioderma          GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGCGCGAG
Gloiocladi163       GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAG
G.furcata           GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Glaciniata          GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Grepens             GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Gloirepens          GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Faucheopsis         GGGCCGCACGCGTGCTACACTGAGCGGATCAACGGGTGAGGATGCGCGAA
Webervanbossea      GGGCCGCACGCGTGCTACACTGAGCGGGTCAACGGGTGAGGATGCGCGAG
                    *************** *********** ********  ***     **

Chy.verticillata    AGCATTGCCTAATCTCTAAATTCGCTCGTGATTGGGATAGAGGCTTGCAA
Gastroclonium       AGCATTGCCTAATCTCTAAATTCGCTCGTGATTGGGATAGAGGCTTGCAA
Chy.schneideri      AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
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C.irregularis202	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.irregularis203	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Coelothrix171	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.harveyana177	AATACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.harveyana160	AATACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Chharv194	AATACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Ch.parvula173	AGTACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.parvula198	AGTATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Ch.sali195	AGTACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.sali161	AGTACTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Champia214	AGCATTTCCCAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Champia214a	AGCATTTCCCAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.vieillardii	AACATTTCCCAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Chviellar221	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
C.vieillardii286	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Ch.affinis	AATATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATAGAGGCTTGCAA
Dictyothamnion	AGTACTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Hymenocladia	AGCGCTTCCTAATCTCTAAATCCGCTCGTGATGGGGATCGAGGCTTGCAA
Erythrymenia	AGCGTTTCCTAATCTCTAAATCCGCTCGTGATGGGGATCGAGGCTTGCAA
Abermudensis	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATCGAGGCTTGCAA
Apeltata	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATCGAGGCTTGCAA
Asteranastomosans	AGCATTTCCTAATCTCTAAATCCGCTCGTGATGGGGATCGAGGCTTGCAA
Ch.nodulosa	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.agardhii	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Gloiosaccion	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Chornata	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Maripelta	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Drouetia	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Coelarthrum236	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.clifton235	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.cliftonii	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
New genus	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
New genus	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Erythrocolon	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Coelaopuntia	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Chamaebotrys231	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Chamaebotrys232	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Halichrysis	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Hmicans	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
B.iridescens	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
B.irri	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
B.spinulifera	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Bspinulifera144	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Leptosomia	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Cephaleucobotrys	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Cephafurcellata	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Sparlingia	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Irvinea	AGCGTTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Rhodymenia240	AGCATTTCCAAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Rhodymenia	AGCATTTCCAAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Rhodyleptophylla	AGCATTTCCAAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Epymenia	AGCATTTCCAAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Cordylecladia	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Bwynnei218	AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA

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B.wynnei            AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Bleptopoda          AGCATTTCCCAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Bebriosa            AGCATTTCCCAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Bsonderi            AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
B.occidentalis      AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.wrightii          AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.wrightii          AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.enteromorpha201   AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
C.enteromorpha143   AGCATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Halymenia           AGCGCTTCCCAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Sebdenia            AGCGCTTCCCAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Fryeella            AGTATTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Hymenocladiopsis    AGCGTTTCCTAATCTCTAAATCCGCTCGTGCTGGGGATCGAGGCTTGCAA
Lomentaria183       AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Lomentaria145       AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Lombaileyana        AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Lomaustralis        AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Ceraintricat        AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Ceratodict          AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Ceratodictyon       AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Semnocarpa          AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Gloioderma          AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Gloiocladi163       AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
G.furcata           AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Glaciniata          AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Grepens             AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Gloirepens          AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Faucheopsis         AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
Webervanbossea      AGCGTTTCCTAACCTCTAAATCCGCTCGTGATGGGGATTGAGGCTTGCAA
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Chy.verticillata    TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Gastroclonium       TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Chy.schneideri      TTCTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.irregularis202    TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.irregularis203    TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Coelothrix171       TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.harveyana177      TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.harveyana160      TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Chharv194           TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Ch.parvula173       TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.parvula198        TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Ch.sali195          TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.sali161           TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Champia214          TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Champia214a         TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.vieillardii       TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Chviellar221        TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
C.vieillardii286    TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Ch.affinis          TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Dictyothamnion      TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Hymenocladia        TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Erythrymenia        TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Abermudensis        TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
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Apeltata	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Asteranastomosans	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Ch.nodulosa	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.agardhii	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Gloiosaccion	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Chornata	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Maripelta	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Drouetia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Coelarthrum236	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.clifton235	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.cliftonii	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
New genus	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
New genus	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Erythrocolon	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Coelaopuntia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Chamaebotrys231	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Chamaebotrys232	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Halichrysis	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Hmicans	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
B.iridescens	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
B.irri	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
B.spinulifera	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Bspinulifera144	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Leptosomia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Cephaleucobotrys	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Cephafurcellata	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Sparlingia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
Irvinea	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Rhodymenia240	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Rhodymenia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Rhodyleptophylla	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Epymenia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Cordylecladia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Bwynnei218	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCATGGGTCATCATCCCGT
B.wynnei	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCAGGGGTCATCATCCCGT
Bleptopoda	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Bebriosa	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Bsonderi	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
B.occidentalis	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.wrightii	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.wrightii	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.enteromorpha201	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
C.enteromorpha143	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Halymenia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCGCGGGTCATCATCCCGT
Sebdenia	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCGCGGGTCATCATCCCGT
Fryeella	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Hymenocladiopsis	TTTTCCCTCTTGAACGAGGAATACCTTGTAAGCACGGGTCATCATCCCGT
Lomentaria183	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Lomentaria145	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Lombaileyana	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Lomaustralis	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Ceraintricat	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Ceratodict	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Ceratodictyon	TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT

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Semnocarpa          TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Gloioderma          TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Gloiocladi163       TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
G.furcata           TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Glaciniata          TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Grepens             TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Gloirepens          TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Faucheopsis         TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
Webervanbossea      TTTTCCCTCATGAACGAGGAATACCTTGTAGGCACGGGTCATCATCCCGT
                    ** ****** ******************** **  ***************


Chy.verticillata    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Gastroclonium       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chy.schneideri      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.irregularis202    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.irregularis203    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Coelothrix171       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.harveyana177      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.harveyana160      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chharv194           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ch.parvula173       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.parvula198        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ch.sali195          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.sali161           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Champia214          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Champia214a         GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.vieillardii       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chviellar221        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.vieillardii286    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ch.affinis          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Dictyothamnion      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Hymenocladia        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Erythrymenia        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Abermudensis        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Apeltata            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Asteranastomosans   GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ch.nodulosa         GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.agardhii          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Gloiosaccion        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chornata            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Maripelta           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Drouetia            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Coelarthrum236      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.clifton235        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.cliftonii         GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
New genus           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
New genus           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Erythrocolon        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Coelaopuntia        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chamaebotrys231     GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Chamaebotrys232     GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Halichrysis         GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Hmicans             GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
B.iridescens        GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
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B.irri              GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
B.spinulifera       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Bspinulifera144     GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Leptosomia          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Cephaleucobotrys    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Cephafurcellata     GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Sparlingia          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Irvinea             GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Rhodymenia240       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Rhodymenia          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Rhodyleptophylla    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Epymenia            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Cordylecladia       GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Bwynnei218          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
B.wynnei            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Bleptopoda          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Bebriosa            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Bsonderi            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
B.occidentalis      GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.wrightii          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.wrightii          GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.enteromorpha201   GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
C.enteromorpha143   GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Halymenia           GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Sebdenia            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Fryeella            GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Hymenocladiopsis    GCTGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Lomentaria183       GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Lomentaria145       GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Lombaileyana        GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Lomaustralis        GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ceraintricat        GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ceratodict          GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Ceratodictyon       GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Semnocarpa          GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Gloioderma          GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Gloiocladi163       GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
G.furcata           GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Glaciniata          GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Grepens             GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Gloirepens          GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Faucheopsis         GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
Webervanbossea      GCCGAATACGTCCCTGCCCTTTGTACACACCGCCCGTCGCTCCTACCGAT
                    ** ***********************************************

Chy.verticillata    TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
Gastroclonium       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
Chy.schneideri      TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
C.irregularis202    TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
C.irregularis203    TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
Coelothrix171       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGTGGACTGTG-TTTCACA
C.harveyana177      TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
C.harveyana160      TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
Chharv194           TGAGTGGTCCGGTGAGGCCTTGGGAGGATTAGGTGGATTGTG-TTTCACA
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Ch.parvula173	TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
C.parvula198	TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
Ch.sali195	TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
C.sali161	TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAGGTGGATTGTG-TTTCACA
Champia214	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
Champia214a	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
C.vieillardii	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
Chviellar221	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
C.vieillardii286	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
Ch.affinis	TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGGTGGATTGTG-TTTCACA
Dictyothamnion	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATGGATTGTG-TTTCACA
Hymenocladia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGACTGTGTAAT-ACA
Erythrymenia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATGGACCGTGTCAT-ACG
Abermudensis	TGAGTGGTCCGGTGAGGCCTAGGGAGGGCTAGATGGACCGTATTTTTACG
Apeltata	TGAGTGGTCCGGTGAGGCCTAGGGAGGGCTAGATGGACCGTATTTTTACG
Asteranastomosans	TGAGTGGTCCGGTGAGGCCTAGGGAGGGCTAGATGGACCGTATTTTTACG
Ch.nodulosa	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGAGAACTGTGTTTCCACG
C.agardhii	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGAGAACTGTGTTTCCACG
Gloiosaccion	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAGAGAACTGTGTTTCCACG
Chornata	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAGAGAACTGTGTCTCCACG
Maripelta	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAAAGAACTGTGTTTACACG
Drouetia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAAGGAACTGTGTTTCCACA
Coelarthrum236	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
C.clifton235	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
C.cliftonii	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
New genus	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
New genus	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
Erythrocolon	TGAGTGGTCCGGTGAGGCACTGGGAGGGCTGAACGAACTGTGTTTCCACG
Coelaopuntia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
Chamaebotrys231	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
Chamaebotrys232	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
Halichrysis	TGAGTGGTCCGGCGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
Hmicans	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACA
B.iridescens	TGAGTGGTCCGGTAAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACG
B.irri	TGAGTGGTCCGGTAAGGCCTTGGGAGGGCTGAACGAACTGTGTTTCCACG
B.spinulifera	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
Bspinulifera144	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
Leptosomia	TGAGTGGTCCGGTGAGGCCTTGGGAGGTCCAAACGAACTGTGCTCGCACA
Cephaleucobotrys	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAACGTAGTGTGTTTCCACA
Cephafurcellata	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAACGTAGTGTGTTTCCACA
Sparlingia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGACTGTGTTTTAACA
Irvinea	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAGTGGACTGTGTTCTCACA
Rhodymenia240	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGAACTGTGTTCTCACA
Rhodymenia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACG
Rhodyleptophylla	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACG
Epymenia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTATCACG
Cordylecladia	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTTACACG
Bwynnei218	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGGTGGATTGTGTTCTCACA
B.wynnei	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGGTGGATTGTGTTCTCACA
Bleptopoda	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
Bebriosa	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
Bsonderi	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACA
B.occidentalis	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACA
C.wrightii	TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACA

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C.wrightii          TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTCTCACA
C.enteromorpha201   TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
C.enteromorpha143   TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGAATGGACTGTGTTCTCACA
Halymenia           TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATAGTCGGTGTTTTCACA
Sebdenia            TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATAGACTGTGTTT-CACA
Fryeella            TGAGTGGTCCGGCGAGGCCTTGGGAGGGCTAAATGGACTGTGTCTTCACA
Hymenocladiopsis    TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAATGGACTGTGTTTTCACA
Lomentaria183       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGCTTGT--TTTTACA
Lomentaria145       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGCCTGT--TTTTACA
Lombaileyana        TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGCCTGT--TTTTACA
Lomaustralis        TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGCCTGT--TTTTACA
Ceraintricat        TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTGGATGGTCTGT--TTTTACA
Ceratodict          TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATGGTCTGT--TTTTACA
Ceratodictyon       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAGATGGTTTGT--CTTTACA
Semnocarpa          TGAGTGGTCCGGTGAGGGATTGGGAGGACTGGATGGTCTGA--TTTTACA
Gloioderma          TGAGTGGTCCGGTGAGGCCTTGGGAGGGTTAAACGGACTGTGTTTTCACA
Gloiocladi163       TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGCGGACTGT--TTTTACA
G.furcata           TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGCGGACTGT--TTTTACA
Glaciniata          TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGCGGACTGT--TTTTACA
Grepens             TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGCGGACTGT--TTTTACA
Gloirepens          TGAGTGGTCCGGTGAGGCCTTGGGAGGGCTAAGCGGACTGT--TTTTACA
Faucheopsis         CGAATGCTAAGGTGAGGCCGTAGGAGGGTTAAGCGGACTGT--ATTCACA
Webervanbossea      TGAGTGGTCCGGTGAGGCCTTGGGAGGACTAGATGGACTGTGGTTACACA
                     ** ** *  **  ***     *****            *       **

Chy.verticillata    GATCGCCGAGCCCAAAGCTTG
Gastroclonium       GATCGCCGAGCCCAAACTTGG
Chy.schneideri      GACTGCCGAGCCCAAAGCTTG
C.irregularis202    GACCGCCGAGCCCAAAGCTTG
C.irregularis203    GACCGCCGAGCCCAAAGCTTG
Coelothrix171       GACCGCCGAGCCCAAAGCTTG
C.harveyana177      GACCGCCGAGCCCAAAGCTTG
C.harveyana160      GACCGCCAAGCCCAAAGCTTG
Chharv194           GACCGCCCAGCCCAAAGCTGG
Ch.parvula173       GACCGCCGTGCCCAAAGCTTG
C.parvula198        GACCGCCGTGCCCAAAGCTTG
Ch.sali195          GACCGCCGTGCCCAAAGCTTG
C.sali161           GACCGCCGTGCCCAAAGCTTG
Champia214          GACTGCCCAGTCCAAACTTGG
Champia214a         GACTGCCCAGTCCAAACTTGG
C.vieillardii       GACTGCCCAGTCCAAAGCTTG
Chviellar221        GACCGCCCAGTCCAAACTTGG
C.vieillardii286    GACCGCCCAGTCCAAACTTGG
Ch.affinis          GACTGCCCAGTCCAAAGCTTG
Dictyothamnion      GACCTACTGGCCCAAAGCTTG
Hymenocladia        GCTTGTCTGGCCCAAACTTGG
Erythrymenia        GACTGTCTGGCCCAAACTTGG
Abermudensis        GACTGTCTGGCCCAAACCAGG
Apeltata            GACTGTCTGGCCCAAACCAGG
Asteranastomosans   GACTGTCTGGCCCAAACCAGG
Ch.nodulosa         GATCTTTTGGCCCAAACTTGG
C.agardhii          GATCTTTTGGCCCAAACTTGG
Gloiosaccion        GATCTTTTGGCCCAAACTTGG
Chornata            GATCTTTTGGCCCAAACTTGG
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Maripelta	GATCTTTTGGCCCCAACTTGG
Drouetia	GATCATTTGGCCCAAACTTGG
Coelarthrum236	GATCATTTGGCCCAAACTTGG
C.clifton235	GATCATTTGGCCCAAACTTGG
C.cliftonii	GATCATTTGGCCCAAACTTGG
New genus	GATCATTTGGCCCAAACTTGG
New genus	GATCATTTGGCCCAAACTTGG
Erythrocolon	GATCATTTGGCCCAAACTTGG
Coelaopuntia	GATCATTTGGCCCAAACTTGG
Chamaebotrys231	GATCATTTGGCCCAAACTTGG
Chamaebotrys232	GATCATTTGGCCCAAACTTGG
Halichrysis	GATCATTTGGCCCAAACTTGG
Hmicans	GATCATTTGGCCCAAACTTGG
B.iridescens	GATCATTTGGCCCAAACTTGG
B.irri	GATCATTTGGCCCAAACTTGG
B.spinulifera	GACCGTTTGGCCCAAACTTGG
Bspinulifera144	GACCGTTTGGCCCAAACTTGG
Leptosomia	GAACGTTTGGCCCAAACTTGG
Cephaleucobotrys	TGTCATTTGGCCCAAACTTGG
Cephafurcellata	TGTCATTTGGCCCAAACTTGG
Sparlingia	GACCATTTGGCCCAAACTTGG
Irvinea	GACCGTTTGGCCCAAACTTGG
Rhodymenia240	GACCGTTTGGCCCAAACTTGG
Rhodymenia	GACCGTTTGGCCCAAACTTGG
Rhodyleptophylla	GACCGTTTGGCCCAAACTTGG
Epymenia	GACCGTTTGGCCCAAACTTGG
Cordylecladia	GACCGTTTGGCCCAAACTTGG
Bwynnei218	GACTGCCCAGCCCAAACTTGG
B.wynnei	GACTGCCCAGCCCAAACTTGG
Bleptopoda	GACTATTTGGCCCAAACTTGG
Bebriosa	GACTGTTTGGCCCAAACTTGG
Bsonderi	GACTATTTGGCCCAAACTTGG
B.occidentalis	GACTGTTTGGCCCAAACTTGG
C.wrightii	GACTATTTGGCCCAAACTTGG
C.wrightii	GACTATTTGGCCCAAACTTGG
C.enteromorpha201	GACTATTTGGCCCAAACTTGG
C.enteromorpha143	GACTATTTGGCCCAAACTTGG
Halymenia	GATCATCTGGCCCAAACTTGG
Sebdenia	GACCATTTGGCCCGAACTTGG
Fryeella	GACCTTCTGGCCCAAACTTGG
Hymenocladiopsis	GACCTTCTGGCCCAAACTTGG
Lomentaria183	GGCTGTCTGGTCTAAACTTGG
Lomentaria145	GTCTATCTGGTCTAAACTTGG
Lombaileyana	GACTATCTGGTCTAAACTTGG
Lomaustralis	GACTGTCTGGTCTAAACTTGG
Ceraintricat	GACTGTCTGGTCTGAACTTGG
Ceratodict	GACTGTCTGGTCTAAACTTGG
Ceratodictyon	GACTGTCTGGTCTAAACTTGG
Semnocarpa	GACTGTCTGGTCTGAACTTTC
Gloioderma	GACTGCTTAGTCTCAACTTGG
Gloiocladi163	GACCGTTTAGTCTAAACTTGG
G.furcata	GACCGTTTAGTCTAAACTTGG
Glaciniata	GACCGTTTAGTCTGAACTTGG
Grepens	GACCGTTTAGTCTAAACTTGG

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Gloirepens          GACCGTTTAGTCTAAACTTGG
Faucheopsis         GACCGTTTAGTCTAAATTTGG
Webervanbossea      GACTGCCTGGTCTAAACTTGG
                             * *  **
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Appendix 3: Alignment of rubisco large subunit (*rbc*L) DNA sequences

Abbreviations and symbols used in the alignment (names are in the same order as they appear in the alignment)

Chamaebot232 = *Chamaebotrys* sp.
Chamaebot231 = *Chamaebotrys* sp.
Coelclif235 = *Coelarthrum cliftonii*
C.parvula198 = *Champia* cfr. *parvula*
C.parvula173 = *Champia* cfr. *parvula*
Chacompressa = *Champia compressa*
Champia214N = *Champia* sp. nov.
Champia214Na = *Champia* sp. nov.
Cvieillar221 = *Champia vieillardii*
Cvieillar286 = *Champia vieillardii*
C.harv177 = *Champia harveyana*
Chharv160 = *Champia harveyana*
Chharv194 = *Champia harveyana*
C.sali161 = *Champia salicornioides*
chsali195 = *Champia salicornioides*
Neogastro = *Neogastroclonium subarticulatum*
Neogastro = *Neogastroclonium subarticulatum*
Chylocladia = *Chylocladia schneideri*
Coelothrix = *Coelothrix irregularis*
Coelo215 = *Coelothrix irregularis*
Halymenia = *Halymenia floresii*
Lhako = *Lomentaria hakodatensis*
Lhako = *Lomentaria hakodatensis*
Ceratodicti = *Ceratodictyon* sp.
Cerato = *Ceratodictyon spongiosum*
Lcatenata = *Lomentaria catenata*
Gloioc = *Gloiocladia laciniata*
Chagardhii = *Chrysymenia agardhii*
Chprocumbens = *Chrysymenia procumbens*
Centero143 = *Chrysymenia enteromorpha*
Centero201 = *Lomentaria hakodatensis*
Botry = *Botryocladia caraibica*
B.caraibica = *Botryocladia caraibica*
Bocci172 = *Botryocladia occidentalis*
B.occid2 = *Botryocladia occidentalis*
B.pyriformis = *Botryocladia pyriformis*
B.ebriosa = *Botryocladia ebriosa*
Bspin = *Botryocladia spinulifera*
Bcana = *Botryocladia canariensis*
Bskott = *Botryocladia skottsbergii*
Bpapen = *Botryocladia papenfussiana*

Botryocladia = *Botryocladia* sp.
B.botryoides = *Botryocladia botryoides*
Bmada = *Botryocladia madagascariensis*
Birri224 = *Botryocladia iridescens*
B.shanskii = *Botryocladia shanksii*
B.monoica = *Botryocladia monoica*
B.uvarioides = *Botryocladia uvarioides*
Rhodymenia = *Rhodymenia intricata*
Rhodysp. = *Rhodymenia* sp.
Rpseud = *Rhodymenia pseudopalmata*
Rdiva240 = *Rhodymenia divaricata*
E.capensis = *Epymenia capensis*
Epymenia = *Epymenia obtusa*
E.wilsonis = *Epymenia wilsonis*
Rskott = *Rhodymenia skottsbergii*
R.corallina = *Rhodymenia corallina*
Cwright = *Chrysymenia wrightii*
Ch.wrightii = *Chrysymenia wrightii*
Irvinea = *Irvinea ardreana*
Iboer = *Irvinea boergesenii*
Maripelta = *Maripelta rotata*
Cordyle = *Cordylecladia erecta*
Halichrysis = *Halichrysis micans*
*= conserved nucleotide
- = gap or missing data

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CLUSTAL 2.0.10 multiple sequence alignment


Chamaebot232 GATGTAGTAGAAACTG------TATTAGCTTAATATTTCGTGTAACTCCACAACCAGGCG
Chamaebot231 GATGTAGTAGAAACTG------TATTAGCTTAATATTTCGTGTAACTCCACAACCAGGCG
Coelclif235  GATGTAGTAGAGACTA------TTTTAGCTTAATATTTCGTGTAACTCCACAGCCAGGCG
C.parvula198 GTAGTTAAGAAAACTGATG---TATTAGCTC--TTTTTCGTGTAAGTCCTCAACCAGGTG
C.parvula173 GTAGTTAAGAAAACTGATG---TATTAGCTC--TTTTTCGTGTAAGTCCTCAACCAGGTG
Chacompressa GTAGTTAAAGAAACTGATA---TATTAGCTC--TTTTTCGTGTAAGTCCTCAACCAGGTG
Champia214N  GTTGTTAAAGAGACTGATG---TATTAGCTC--TTTTTCGTGTAAGTCCTCAACCAGGTG
Champia214Na GTTGTTAAAGAGACTGATG---TATTAGCTC--TTTTTCGTGTAAGTCCTCAACCAGGTG
Cvieillar221 GTAGTTAAGAAAACAGATA---TATTAGCTC--TATTTCGTGTAAGTCCTCAGCCAGGTG
Cvieillar286 GTGGTTAAAGAAACAGATG---TATTAGCTC--TATTTCGTGTAAGTCCTCAGCCAGGTG
C.harv177    GTTGTTAAGAACACAGATA---TTTTAGCTC--TATTTCGTGTAACACCTCAACCAGGTG
Chharv160    GTTGTTAAGAACACAGATA---TTTTAGCTC--TATTTCGTGTAACACCTCAACCAGGTG
Chharv194    GTTGTTAAGAACACAGATA---TTTTAGCTC--TATTTCGTGTAACACCTCAACCAGGTG
C.sali161    GTTGTTAAGGACACAGATA---TTTTAGCTC--TATTTCGTGTAACACCTCAACCAGGTG
chsali195    GTTGTTAAAGACACAGATA---TTTTAGCTC--TATTTCGTGTAACACCTCAGCCAGGTG
Neogastro    GTTGTTAAGAAAACTGATC---TTTTAGCAC--TGTTTCGTGTAACCCCTCAGCCAGGTG
Neogastro    GTTGTTAAGAAAACTGATC---TTTTAGCAC--TGTTTCGTGTAACCCCTCAGCCAGGTG
Chylocladia  GTTGTTAAGAAAACAGATC---TTTTAGCTC--TGTTTCGTGTAACTCCTCAGCCAGGTG
Coelothrix   GTTGTTAAGGATACAGATG---TTTTAGCCC--TGTTTCGTGTAACTCCTCAGCCAGGTG
Coelo215     GTTGTTAAGGATACAGATG---TTTTAGCCC--TGTTTCGTGTAACTCCTCAGCCAGGTG
Halymenia    GTAGTTAAAGAAACTGATG---TATTAGCTT--TATTTCGTGTAACTCCACAACCAGGTG
Lhako        -------------------------------------CCGTGTAACTCCACAACCTGGCG
Lhako        --------------------------------------CGTGTAACTCCACAACCTGGCG
Ceratodicti  GTAGTTAAAGAGACTGATA---TATTAGCTC--TATTCCGTGTAACTCCACAGCCAGGTG
Cerato       ------------------------------------------------------------
Lcatenata    -----------------------------C--TATTTCGTGTAACTCCACAACCAGGTG
Glioc        GTAGTAAAAGAAACTGATA---TTTTAGCTC--TGTTCCGTGTAACTCCACAACCAGGTG
Chagardhii   GATGTGATAGAAACT------ATATTAGCTTACTATTTCGCGTAACTCCACAGCCAGGTG
Chprocumbens GATGTAGTA-A-ACT-------T-TTAGCTT--TATT-CG-GTAACTCCACAACCAGGTG
Centero143   GATGTTGTAACACCT------GTCTTAGCTTACTATTTCGTGTAACTCCACAGCCTGGTG
Centero201   GATGTTGTAACACCT------GTCTTAGCTTACTATTTCGTGTAACTCCACAGCCTGGTG
Botry        GGCGTAATTCCATATGCTAAAAT---GGGATACTATTTCGTGTAACTCCACAACCAGGTG
B.caraibica  GGCGTAATTCCATATGCTAAAAT---GGGATACTATTTCGTGTAACTCCACAACCAGGTG
Bocci172     GATGTTGTTAAAGATACTGATGTTTTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
B.occid2     GATGTTGTTAAAGATACTGATGTTTTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
B.pyriformis G--GT--TT--A-A--CT-A--T-------TACTATT-CGTGTAACTCCACA-CCAGGTG
B.ebriosa    GGCGTAATTCCATATGCTAAAAT---GGGATACTATTTCGTGTAACTCCACAACCAGGTG
Bspin        GGCGTAATTCCATATGCTAAAAT---GGGATACTATTTCGTGTAACTCCACAACCAGGTG
Bcana        G--GT--TT--A-A--C--A--T----G--TACTATT-CGTGTAACTCCACAACCAGGTG
Bskott       G--GT--TT--A-AT-CT----T----G-TTACTATTTCGTGTAACTCCACAACCAGGTG
Bpapen       GATGTGGTTAAGACTNCTGATATTTTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
Botryocladia GATGTGGTTAAAGATACTGATATTTTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
B.botryoides GATGTGGTTAAAGATACTGATATTTTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
Bmada        GATGTAGTTAAAGATACTGATGTATTAGCTTACTATTTCGTGTAACTCCACAACCAGGTG
Birri224     GATGTAGTTAAAGATACTGATGTTTTAGCTTACTATTTCGTGTAACTCCACAGCCAGGTG
B.shanskii   GATGTGGTTAAAGACACTGATGTTTTAGCTTACTATTCCGTGTAACTCCACAGCCAGGTG
B.monoica    GATGTGGTTAAAGACACTGATGTTTTAGCTTACTATTCCGTGTAACTCCACAGCCAGGCG
B.uvarioides GACGTGGTTAAAGACACCGATGTTTTAGCTTACTATTTCGCGTAACTCCACAACCGGGCG
Rhodymenia   GACGTAGTTAAAGATACTGATATTTTAGCTT--TATTCCGGGTAACTCCACAGCCAGGCG
Rhodysp.     GACGTAGTTAAAGATACTGATATTTTAGCTT--TATTCCGGGTAACTCCACAGCCAGGCG
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Rpseud        GACGTAGTTAAAGATACTGATATTTTAGCTT--TATTCCGGGTAACTCCACAGCCAGGCG
Rdiva240      GACGTGATTAAAGATACTGATATACTAGCTT--TATTTCGTGTAACTCCACAGCCAGGTG
E.capensis    GATGTAGT---AGATACT---ATTTTAGCTT--TATTTCGCGTAACTCCACAACCAGGTG
Epymenia      GATGTAGT---AGATACT---ATTTTAGCTT--TATTCCGCGTAACTCCACAACCAGGTG
E.wilsonis    GACGTAGT---AGATACT---ATTTTAGCTT--TATTCCGCGTAACTCCACAACCAGGTG
Rskott        GATGTAGTTAAAGATACTGATATTTTAGCTT--TATTTCGTGTAACTCCACAACCAGGTG
R.corallina   GATGTAGTTAAAGATACTGATATCTTAGCTT--TATTTCGTGTAACTCCACAACCAGGTG
Cwright       -ATGTGGTTAAAGATACTGATGTTTTAGCTC--TATTCCGTGTAAGTCCACAGCCAGGTG
Ch.wrightii   -ATGTGGTTAAAGATACTGATGTTTTAGCTC--TATTCCGTGTAAGTCCACAGCCAGGTG
Irvinea       GGCGTAATTCCATATGCTAAAAT---GGGATACTATTTCGTGTAACTCCACAACCAGGTG
Iboer         GATGTAGTTAAAGAGACTAATGTGCTAGCTTCTTATTTCGTGTAACTCCGCAACCAGGTG
Maripelta     GATGTGGTTAAAGAG-CTGATATTTTAGCTT--ATTCCCGTGTAACTCCACAACCAGGTG
Cordyle       GATGTGGTTAAAGAGACNGATATTTTAGCT--CTATTCCGTGTAACTCCACAACCAGGTG
Halichrysis   G--G-----------------------CT--CTATTTCGCGTAACTCCACAGCCAGGCG


Chamaebot232 TTGATCCGATTGAAGCTTCTGCTGCAGTTGCAGGTGAGTCGTCTACAGCTACTTGGACAG
Chamaebot231 TTGATCCGATTGAAGCTTCTGCTGCAGTTGCAGGTGAGTCGTCTACAGCTACTTGGACAG
Coelclif235  TTGACCCTATAGAAGCTTCTGCTGCAGTTGCAGGCGAATCATCTACTGCTACTTGGACAG
C.parvula198 TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACTGCTACTTGGACAG
C.parvula173 TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACTGCTACTTGGACAG
Chacompressa TTGATCCAGTAGAAGCCTCAGCTGCAGTTGCAGGTGAATCTTCTACTGCTACTTGGACAG
Champia214N  TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACTGCTACTTGGACAG
Champia214Na TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACTGCTACTTGGACAG
Cvieillar221 TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACAGCTACTTGGACAG
Cvieillar286 TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCAGGTGAATCTTCTACAGCTACTTGGACAG
C.harv177    TGGATCCAGTAGAAGCTTCAGCTGCAGTTGCTGGTGAATCATCTACAGCTACATGGACAG
Chharv160    TGGATCCAGTAGAAGCTTCAGCTGCAGTTGCTGGTGAATCATCTACAGCTACATGGACAG
Chharv194    TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCTGGTGAATCATCTACAGCTACATGGACAG
C.sali161    TGGATCCAGTAGAAGCTTCAGCTGCAGTTGCTGGTTAATCATCTACAGCTACATGGACAG
chsali195    TGGATCCAGTAGAAGCTTCAGCTGCAGTTGCTGGTGAATCATCTACAGCTACATGGACAG
Neogastro    TTGATCCTATAGAAGCTTCAGCTGCAGTTGCAGGTGAATCGTCTACTGCAACTTGGACAG
Neogastro    TTGATCCTATAGAAGCTTCAGCTGCAGTTGCAGGTGAATCGTCTACTGCAACTTGGACAG
Chylocladia  TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCTTCTACTGCAACTTGGACAG
Coelothrix   TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCGGGTGAATCGTCTACAGCAACTTGGACAG
Coelo215     TTGATCCAGTAGAAGCTTCAGCTGCAGTTGCGGGTGAATCGTCTACAGCAACTTGGACAG
Halymenia    TTGACCCCATAGAAGCTTCTGCTGCTGTTGCTGGTGAATCTTCTACTGCAACTTGGACTG
Lhako        TAGATCCAGTTGAAGCTTCTGCTGCAGCTGCAGGTGAATCATCAACAGCTACTTGGACAG
Lhako        TAGATCCAGTTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCAACAGCTACTTGGACAG
Ceratodicti  TAGATCCAGTAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Cerato       ------------------------------------------------------------
Lcatenata    TAGATCCAGTAGAAGCTTCAGCAGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Gloioc       TAGATCCAGTAGAAGCTTCTGCAGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Chagardhii   TTGACCCTATTGAAGCTTCTGCAGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Chprocumbens TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAGTCATCTACAGCTACTTGGACAG
Centero143   TTGACCCAATCGAAGCTTCTGCGGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Centero201   TTGACCCAATCGAAGCTTCTGCGGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Botry        TTGACCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGGCAG
B.caraibica  TTGACCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGGCAG
Bocci172     TTGACCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.occid2     TTGACCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.pyriformis TTGACCCAAT-GAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.ebriosa    TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Bspin        TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
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Bcana        TTGACCCAAT-GAGGCCTCTGCTGCAGCTGCAGGTGAATCATCTACAGCTACTTGGACAG
Bskott       TTGACCCAATCGAGGCCTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Bpapen       TTGACCCAATCGAGGCCTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Botryocladia TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.botryoides TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Bmada        TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCAACAGCTACTTGGACAG
Birri224     TTGACCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.shanskii   TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.monoica    TTGATCCAATCGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
B.uvarioides TTGACCCAATTGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Rhodymenia   TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Rhodysp.     TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Rpseud       TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Rdiva240     TTGATCCAATAGAGGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
E.capensis   TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Epymenia     TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
E.wilsonis   TTGACCCGATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Rskott       TTGACCCAATAGAAGCCTCTGCTGCAGTTGCGGGTGAGTCATCTACAGCTACTTGGACAG
R.corallina  TTGACCCAATAGAAGCTTCTGCTGCAGTTGCGGGTGAATCATCTACAGCTACTTGGACAG
Cwright      TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Ch.wrightii  TTGATCCAATAGAAGCTTCTGCTGCAGTTGCAGGTGAATCATCTACAGCTACTTGGACAG
Irvinea      TTGACCCAATCGAAGCTGGGATCCTGATTATGGGTGAATCGTCAACAGCTACTTGGACAG
Iboer        TTGACCCTATTGAAGCTTCTGCAGCAGTTGCAGGTGAATCGTCAACAGCTACTTGGACAG
Maripelta    TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGCGAATCATCTACGGCTACTTGGACAG
Cordyle      TTGACCCAATAGAAGCTTCTGCTGCAGTTGCAGGCGAATCATCTACGGCTACTTGGACAG
Halichrysis  TTGATCCTATTGAAGCCTCTGCTGCAGTGGCAGGTGAATCGTCTACAGCTACTTGGACAG


Chamaebot232 TAGTTTGGACGGATTTATTGACAGCTTGCGATTTATATAGAGCAAAAGCTTATAAAGTAG
Chamaebot231 TAGTTTGGACGGATTTATTGACAGCTTGCGATTTATATAGAGCAAAAGCTTATAAAGTAG
Coelclif235  TAGTTTGGACTGATCTACTGACAGCTTGTGACTTATATAGAGCAAAAGCTTATAAGGTAG
C.parvula198 TTGTATGGACTGACTTACTTACAGCTTGTGATCTATATAGAGCAAAAGCATATAAAGTAG
C.parvula173 TTGTATGGACTGACTTACTTACAGCTTGTGATCTATATAGAGCAAAAGCATATAAAGTAG
Chacompressa TTGTATGGACTGACTTACTTACAGCTTGTGATCTATACAGAGCAAAAGCATATAAAGTAG
Champia214N  TTGTATGGACTGACTTACTTACAGCTTGTGATCTATACAGAGCAAAAGCATATAAAGTAG
Champia214Na TTGTATGGACTGACTTACTTACAGCTTGTGATCTATACAGAGCAAAAGCATATAAAGTAG
Cvieillar221 TAGTATGGACTGATTTACTTACAGCTTGTGATCTATATAGAGCAAAAGCTTATAAAGTAG
Cvieillar286 TAGTATGGACTGATTTACTTACAGCTTGTGATCTATATAGAGCAAAAGCTTATAAAGTAG
C.harv177    TAGTTTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCAAAAGCTTATAAAGTTG
Chharv160    TAGTTTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCAAAAGCTTATAAAGTTG
Chharv194    TAGTTTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCAAAAGCTTATAAAGTTG
C.sali161    TAGTCTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCAAAAGCTTATAAAGTTG
chsali195    TAGTCTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCAAAAGCTTATAAAGTGG
Neogastro    TAGTTTGGACTGATCTTTTAACAGCTTGTGATCTATATAGAGCTAAAGCATATAAAGTAG
Neogastro    TAGTTTGGACTGATCTTTTAACAGCTTGTGATCTATATAGAGCTAAAGCATATAAAGTAG
Chylocladia  TAGTTTGGACTGATTTATTAACAGCTTGTGATTTATATAGAGCTAAAGCATATAAAGTTG
Coelothrix   TAGTTTGGACAGATTTATTAACAGCTTGTGATTTGTATAGAGCTAAAGCTTATAAAGTAG
Coelo215     TAGTTTGGACAGATTTATTAACAGCTTGTGATTTGTATAGAGCTAAAGCTTATAAAGTAG
Halymenia    TAGTTTGGACTGATCTATTAACAGCATGTGACCTATACAGAGCTAAAGCATATAAAGTAG
Lhako        TAGTATGGACAGATTTATTAACAGCATGTGATCTTTATAGAGCAGAAGCATATAAAGTAC
Lhako        TAGTATGGACAGATTTATTAACAGCATGTGATCTTTATAGAGCAAAAGCATATAAAGTAG
Ceratodicti  TAGTTTGGACTGATTTATTAACAGCTTGTGATCTATATAGAGCAAAAGCTTATAAAGTAG
Cerato       ------------------------------------------------------------
Lcatenata    TAGTTTGGACTGATTTATTAACAGCGTGTGATTTATATAGAGCAAAAGCTTATAAAGTAG
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Glioc        TAGTTTGGACTGACCTATTGACAGCTTGTGATCTATATAGAGCAAAAGCATATAAAGTAG
Chagardhii   TAGTTTGGACTGATTTATTGACAGCCTGCGACCTATATAGAGCAAAAGCTTATAAAGTAG
Chprocumbens TAGTTTGGACTGAT-TATTAACAGC-TG-GA--TATATAGAGCAAAAGC-TATAAAGTAG
Centero143   TAGTTTGGACTGATCTATTAACAGCTTGTGACTTATATAGAGCAAAAGCTTATAAGGTAG
Centero201   TAGTTTGGACTGATCTATTAACAGCTTGTGACTTATATAGAGCAAAAGCTTATAAGGTAG
Botry        TAGTTTGGACTGAT-T-TT-AC-GCTTG-GA-TTATATAGAGC-AAAGCTTA-AAAGTAG
B.caraibica  TAGTTTGGACTGAT-T-TT-AC-GCTTG-GA-TTATATAGAGC-AAAGCTTA-AAAGTAG
Bocci172     TAGTTTGGACTGATTTGTTGACAGCTTGTGACTTATATAGAGCAAAAGCTTACAAAGTAG
B.occid2     TAGTTTGGACTGATTTGTTGACAGCTTGTGACTTATATAGAGCAAAAGCTTACAAAGTAG
B.pyriformis TAGTTTGGACTGAT-T-TT-AC-GCTTG-GA--TATATAGAGC-AAAGCTTA-A-AGTAG
B.ebriosa    TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
Bspin        TAGTTTGCACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
Bcana        TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTACAGCTTATAGAGTAG
Bskott       TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
Bpapen       TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
Botryocladia TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
B.botryoides TAGTTTGGACTGATTTATTGACTGCTTGCGATTTATATAGAGCTAAAGCTTATAAAGTAG
Bmada        TTGTTTGGACTGATCTATTAACAGCTTGTGACCTATATAGAGCTAAAGCATATAAAGTAG
Birri224     TAGTTTGGACTGATTTATTAACAGCTTGCGATTTATATAGAGCGAAAGCTTATAAAGTAG
B.shanskii   TAGTTTGGACTGATCTATTAACAGCTTGCGATTTATATAGAGCTAAAGCGTATAAAGTAG
B.monoica    TAGTTTGGACTGATCTATTAACAGCTTGCGATTTATATAGAGCGAAAGCTTATAAAGTAG
B.uvarioides TAGTTTGGACTGATCTATTAACAGCTTGTGATTTATATAGAGCGAAAGCTTATAGAGTAG
Rhodymenia   TAGTTTGGACTGATTTATTAACAGCTTGCGACTTATATAGAGCAAAAGCTTATAAAGTAG
Rhodysp.     TAGTTTGGACTGATTTATTAACAGCTTGCGACTTATATAGAGCAAAAGCTTATAAAGTAG
Rpseud       TAGTTTGGACTGATTTATTAACAGCTTGCGACTTATATAGAGCAAAAGCTTATAAAGTAG
Rdiva240     TAGTTTGGACTGATTTATTAACAGCTTGTGACTTATATAGAGCGAAAGCTTATAAAGTAG
E.capensis   TAGTTTGGACTGATTTATTAACAGCTTGTGATCTATATAGAGCAAAGGCATATAAAGTAG
Epymenia     TAGTTTGGACTGATTTATTAACAGCCTGTGATCTATATAGAGCAAAGGCATATAAAGTAG
E.wilsonis   TAGTTTGGACTGATCTATTAACAGCTTGCGATCTATATAGAGCAAAGGCATATAAAGTAG
Rskott       TAGTTTGGACTGATCTACTAACAGCTTGCGATTTATATAGAGCAAAAGCATATAAAGTAG
R.corallina  TAGTTTGGACTGATCTATTAACAGCTTGTGATCTATATAGAGCAAAAGCATATAAGGTAG
Cwright      TAGTTTGGACTGATCTATTAACAGCTTGCGATTTATATAGAGCAAAAGCTTATAAAGTAG
Ch.wrightii  TAGTTTGGACTGATCTATTAACAGCTTGCGATTTATATAGAGCAAAAGCTTATAAAGTAG
Irvinea      TTGTTTGGACTGATCTATTGACAGCTTGCGATTTATATAGAGCAAAGGCTTATAAAGTAG
Iboer        TTGTTTGGACTGATCTATTGACAGCTTGCGATTTATATAGAGCAAAGGCTTATAAAGTAG
Maripelta    TAGTTTGGACTGATCTATTAACAGCTTGTGATCTATATAGAGCAAAAGCTTACAAGGTAG
Cordyle      TAGTTTGGACTGATCTATTAACAGCTTGTGATCTATATAGAGCAAAAGCTTACAAGGTAG
Halichrysis  TAGTTTGGACTGATCTATTAACAGCTTGTGACCTATACAGAGCAAAAGCTTATAAAGTAG


Chamaebot232 AAGCTGTACCCAATTCAACTGAGCAATACTTTGCTTACGTTTCTTACGATATTGATCTTT
Chamaebot231 AAGCTGTACCCAATTCAACTGAGCAATACTTTGCTTACGTTTCTTACGATATTGATCTTT
Coelclif235  AATCTGTGCCAAATTCATCTGAGCAGTACTTTGCTTATGTCTCTTATGATATTGATCTTT
C.parvula198 ATGCTGTACCTAATTCTTCAGAGCAATATTTTGCTTATATTGCATATGATATAGATCTTT
C.parvula173 ATGCTGTACCTAATTCTTCAGAGCAATATTTTGCTTATATTGCATATGATATAGATCTTT
Chacompressa ATGCTGTACCTAATTCTTCAGAGCAATACTTTGCTTATATTGCGTATGATATAGATCTTT
Champia214N  ATGCTGTACCTAATTCTTCAGAGCAATATTTTGCTTATATTGCATATGATATAGATCTTT
Champia214Na ATGCTGTACCTAATTCTTCAGAGCAATATTTTGCTTATATTGCATATGATATAGATCTTT
Cvieillar221 ATGCTGTACCTAACTCTTCAGAACAATACTTTGCTTATATTGCATATGATATAGATCTTT
Cvieillar286 ATGCTGTACCTAACTCTTCAGAACAATACTTTGCTTATATTGCATATGATATAGATCTTT
C.harv177    ATGCTGTACCCAATTCTTCTGATCAATAATTTGCTTATATTGTTTATGATATAGATCTTT
Chharv160    ATGCTGTACCCAATTCTTCTGATCAATAATTTGCTTATATTGTTTATGATATAGATCTTT
Chharv194    ATGCTGTACCCAATTCTTCTGATCAATAATTTGCTTATATTGTTTATGATATAGATCTTT
C.sali161    ATGCTGTACCCAACTCTTCTGATCAATATTTTGCTTATATTGGTTATGATATAGATCTTT
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chsali195    ATGGTGTACCCCACCCTTCCGGACAATTTTTTGCTTATATTGCTTATGATATAGATCTTT
Neogastro    ATGCAGTGCCTAACTCTTCTGATCAATATTTTGCTTATATTGCATATGATATTGATCTTT
Neogastro    ATGCAGTGCCTAACTCTTCTGATCAATATTTTGCTTATATTGCATATGATATTGATCTTT
Chylocladia  ATGCAGTGCCTAACTCTTCTGATCAATATTTTGCTTATATTGCATATGATATTGATCTTT
Coelothrix   ATAAAGTGCCTAATTCTTCTGATCAATATTTTGCTTATATTGCATATGATATAGATCTTT
Coelo215     ATAAAGTGCCTAATTCTTCTGATCAATATTTTGCTTATATTGCATATGATATAGATCTTT
Halymenia    ATGCTGTCCCAAATTCGTCTGATCAATACTTTGCTTATATTTCATATGATATCGATCTAT
Lhako        ATCGTGTACCAAATTCAACCGACCAATACTTCGCTTACATCGCATATGATATTGATCTAT
Lhako        ATCGTGTACCAAATTCAACCGACCAATACTTCGCTTACATCGCATATGATATTGATCTAT
Ceratodicti  ATCCTGTGCCAAATTCAACTGAACAATATTTTGCTTATATTTCATATGATATTGATCTAT
Cerato       ------------------------------------------------------------
Lcatenata    ACCCTGTACCAAATTCAACCGAACAATATTTTGCTTATATTGCATATGATATTGATTTAT
Glioc        ATCCTGTACCAAACTCATCTGAGCAATACTTTGCCTATATTGCCTATGATATAGATCTTT
Chagardhii   ATGCTGTGCCTAATTCATCTGAGCAGTATTTTGCTTATATCTCTTATGATATTGACCTAT
Chprocumbens A--CTGT-CCTAATTCATCTGAGCAATACTTTGCTTA--T--CTTA-GATATTGATCTTT
Centero143   ATTCTGTACCTAATTCATCTGAGCAATACTTTGCTTATATTTCTTATGATATTGATCTTT
Centero201   ATTCTGTACCTAATTCATCTGAGCAATACTTTGCTTATATTTCTTATGATATTGATCTTT
Botry        ATGCTGTACCTAATTCATCTGA-CAATA-TTTGC-TA--T--CTTATGATATTGATCTTT
B.caraibica  ATGCTGTACCTAATTCATCTGA-CAATA-TTTGC-TA--T--CTTATGATATTGATCTTT
Bocci172     ATGCTGTACCTAATTCATCTGAGCAATATTTTGCTTACGTTTCTTATGATATTGATCTTT
B.occid2     ATGCTGTACCTAATTCATCTGAGCAATATTTTGCTTACGTTTCTTATGATATTGATCTTT
B.pyriformis -T-CTGTACCTAA-TCATCTGA-CAATA-TTTGC-TA--T--CTTATGATATTGATCTTT
B.ebriosa    ATTCTGTACCTAATTCATCTGAGCAATACTTTGCCTATGTAGCTTATGATATTGATCTTT
Bspin        ATTCTGTACCTAATTCATCTGAGCAATACTTTGCCTATGTAGCTTATGATATTGATCTTT
Bcana        ATTCTGTACCTACTTCATCTGAGCAATACTTTGCCTATGTAGCTTATGATATTGATCTTT
Bskott       ATTCTGTACCTAATTCATCTGAGCAATACTTTGCCTATGTAGCTTATGATATTGATCTTT
Bpapen       ATTCTGTACCTAATTCATCTGAGCAATACTTTGCCTATGTAGCTTATGATATTGATCTTT
Botryocladia TTTCTGTACCTAATTCATCTGAGCAATACTTTGCATATGTATCTTATGATATTGATCTTT
B.botryoides TTTCTGTACCTAATTCATCTGAGCAATACTTTGCATATGTATCTTATGATATTGATCTTT
Bmada        ATGCTGTACCTAATTCATCTGATCAATATTTTGCTTATGTTGCTTATGATATTGATCTAT
Birri224     ATGCTGTACCTAATTCATCTGAGCAATATTTTGCTTATATTTCTTATGATATTGATCTTT
B.shanskii   ATTCTGTACCTAATTCATCTGAGCAATATTTTGCTTATATTGCTTATGATATTGATCTTT
B.monoica    ATTCTGTACCTAACTCATCTGATCAATACTTTGCTTATATCTCTTATGATATTGATCTTT
B.uvarioides ATGCTGTACCTAATTCATCTGAACAATATTTTGCCTATATTTCTTATGATATTGATCTTT
Rhodymenia   ACTCTGTACCTAATTCATCTGAACAATATTTTGCCTATATTTCTTATGATATTGATCTTT
Rhodysp.     ACTCTGTACCTAATTCATCTGAACAATATTTTGCCTATATTTCTTATGATATTGATCTTT
Rpseud       ACTCTGTACCTAATTCATCTGAACAATATTTTGCCTATATTTCTTATGATATTGATCTTT
Rdiva240     AATCTGTACCTAATTCAACTGAGCAATATTTTGCTTATGTTTCTTATGATATTGATCTTT
E.capensis   ATTCTGTGCCTAACTCATCTGAGCAATACTTTGCTTACGTTGCTTACGATATCGATCTTT
Epymenia     ATTCTGTGCCTAACTCATCTGAGCAATACTTTGCTTACGTTGCTTACGATATTGATCTTT
E.wilsonis   ATTCTGTTCCTAATTCATCTGAGCAATACTTTGCTTACGTTGCTTATGATATTGATCTTT
Rskott       ACTCTGTACCTAATTCATCTGAACAATATTTTGCTTATGTTGCTTACGATATTGATCTTT
R.corallina  ACTCTGTACCTAATTCATCTGATCAATATTTTGCTTATATTGCTTATGATATCGATCTTT
Cwright      ATTCTGTGCCTAATTCATCTGAGCAATATTTTGCTTATGTTGCTTATGATATAGATCTTT
Ch.wrightii  ATTCTGTGCCTAATTCATCTGAGCAATATTTTGCTTATGTTGCTTATGATATAGATCTTT
Irvinea      ATGCTGTACCTAATTCATCTGAACAATATTTTGCTTATGTTTCTTATGATATCGATCTTT
Iboer        ATGCTGTACCTAATTCATCTGAACAATATTTTGCTTATGTTTCTTATGATATCGATCTTT
Maripelta    ACTCTGTGCCTAATTCATCTGAGCAGTACTTTGCTTACGTCTCTTACGATATTGATCTCT
Cordyle      ACTCTGTGCCTAATTCATCTGAGCAGTACTTTGCTTACGTCTCTTACGATATTGATCTCT
Halichrysis  ACGCTGTACCTAACTCATCTGAACAATACTTTGCTTATATAGCTTATGACATCGATCTTT


Chamaebot232 TTGAAGAGGGTTCTATTCCTAACTTAACAGCATCAATTATCGGTAACGTATTTGGCTTCA
Chamaebot231 TTGAAGAGGGTTCTATTCCTAACTTAACAGCATCAATTATCGGTAACGTATTTGGCTTCA
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Coelclif235  TTGAAGAGGGTTCTATTGCAAACTTAACAGCTTCAATTATTGGTAATGTATTTGGTTTCA
C.parvula198 TTAAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAATGTATTTGGTTTTA
C.parvula173 TTAAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAATGTATTTGGTTTTA
Chacompressa TTAAAGAAGGATCAATAGCGAATTTAACAGCATCAATTATTGGTAATGTATTCGGTTTTA
Champia214N  TTGAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAACGTATTTGGTTTTA
Champia214Na TTGAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAACGTATTTGGTTTTA
Cvieillar221 TTGAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAATGTATTTGGTTTTA
Cvieillar286 TTGAAGAAGGATCAATAGCTAATTTAACAGCATCAATTATTGGTAATGTATTTGGTTTTA
C.harv177    TTGAAGAAGGTTCAATAGCTAATTTAACAGCTTCAATTATCGGTAATGTATTTGGTTTTA
Chharv160    TTGAAGAAGGTTCAATAGCTAATTTAACAGCTTCAATTATCGGTAATGTATTTGGTTTTA
Chharv194    TTGAAGAAGGTTCAATAGCTAATTTAACAGCTTCAATTATCGGTAATGTATTTGGTTTTA
C.sali161    TTGAAGAAGGTTCAATAGCTAATTTAACAGCTTCAATTATCGGTAATGTATTTGGTTTTA
chsali195    TTGAAGAAGGTTCAATAGCTAATTTAACAGCTTCAATTATCGGTAATGTATTTGGTTTTA
Neogastro    TTGAAGAAGGATCAATAGCAAATTTAACAGCATCAATTATAGGTAATGTTTTTGGTTTTA
Neogastro    TTGAAGAAGGATCAATAGCAAATTTAACAGCATCAATTATAGGTAATGTTTTTGGTTTTA
Chylocladia  TTGAAGAAGGATCAATAGCAAATTTAACAGCATCAATTATTGGTAATGTATTCGGTTTTA
Coelothrix   TTGAAGAAGGATCGATTGCTAACTTAACAGCATCAATTATTGGTAATGTATTTGGCTTTA
Coelo215     TTGAAGAAGGATCGATTGCTAACTTAACAGCATCAATTATTGGTAATGTATTTGGCTTTA
Halymenia    TTGAAGAAGGTTCTATAGCTAATCTAACAGCTTCAATTATTGGTAATGTATTTGGTTTTA
Lhako        TTGAAGAAGGTTCAATAGCTAACTTAACAGCTTCTATTATTGGTAATGTTTTTGGATTTA
Lhako        TTGAAGAAGGTTCAATAGCTAACTTAACAGCTTCTATTATTGGTAANGTTTTTGGATTTA
Ceratodicti  TTGAAGAAGGATCTATTGCTAACTTAACAGCTTCTATTATTGGTAATGTATTTGGTTTTA
Cerato       -----------------------------------------------------GGTTTTA
Lcatenata    TTGAAGAAGGTTCTATTGCTAACTTAACAGCTTCTATTATTGGTAATGTGTTTGGTTTTA
Glioc        TTGAAGAAGGTTCTATTGCTAACTTAACAGCATCAATTATTGGTAACGTATTTGGCTTTA
Chagardhii   TTGAAGAAGGATCTATTGCAAACTTAACAGCTTCAATTATTGGTAACGTTTTTGGTTTCA
Chprocumbens TTGAAGAAGGATCTATAGCTAACTTAACAGCTTCAATTATTGGTAACGTATTTGGATTTA
Centero143   TTGAAGAAGGATCTATAGCAAATTTAACTGCTTCAATTATTGGTAATGTATTTGGCTTTA
Centero201   TTGAAGAAGGATCTATAGCAAATTTAACTGCTTCAATTATTGGTAATGTATTTGGCTTTA
Botry        TTGAGGAAGGATCTATAGCAAA--TAAC-GCTTC-AT-ATCGGTAA-GTATTCGGCTTTA
B.caraibica  TTGAGGAAGGATCTATAGCAAA--TAAC-GCTTC-AT-ATCGGTAA-GTATTCGGCTTTA
Bocci172     TTGAGGAAGGATCTATAGCAAATTTAACTGCTTCGATTATCGGTAATGTATTCGGCTTTA
B.occid2     TTGAGGAAGGATCTATAGCAAATTTAACTGCTTCGATTATCGGTAATGTATTCGGCTTTA
B.pyriformis TTGA-GAAGGATCTATAGCAAA--TAAC-GCTTC--T-AT-GGTAA-GTATTTGG-TTTA
B.ebriosa    TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
Bspin        TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
Bcana        TTGAAGAAGGATCTATAGCACACTTAACTGCTTCAATTATTGGTAACGAATTTGGCTTTA
Bskott       TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
Bpapen       TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
Botryocladia TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
B.botryoides TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGCTTTA
Bmada        TTGAAGAAGGATCAATAGCTAACTTAACAGCTTCAATTATTGGTAATGTTTTTGGCTTTA
Birri224     TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATTATTGGTAACGTATTTGGCTTTA
B.shanskii   TTGAGGAAGGATCTATAGCAAACTTAACCGCTTCAATTATTGGTAACGTATTTGGCTTTA
B.monoica    TTGAAGAAGGATCTATAGCAAACTTAACTGCTTCAATTATTGGTAACGTATTTGGTTTTA
B.uvarioides TTGAAGAAGGATCTATCGCAAACCTAACTGCTTCAATCATTGGTAACGTATTTGGCTTTA
Rhodymenia   TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTATTTGGTTTTA
Rhodysp.     TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTATTTGGTTTTA
Rpseud       TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTATTTGGTTTTA
Rdiva240     TTGAAGAAGGATCTATTGCAAACTTAACAGCTTCAATTATTGGTAATGTATTTGGCTTTA
E.capensis   TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTATTTGGTTTTA
Epymenia     TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTATTTGGCTTTA
E.wilsonis   TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATTATTGGTAATGTATTTGGCTTTA
Rskott       TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATTATTGGTAACGTATTTGGCTTTA
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R.corallina  TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGCAATGTATTCGGCTTTA
Cwright      TTGAAGAAGGATCTATAGCAAATTTAACAGCTTCAATTATCGGTAACGTGTTTGGCTTTA
Ch.wrightii  TTGAAGAAGGATCTATAGCAAATTTAACAGCTTCAATTATCGGTAACGTGTTTGGCTTTA
Irvinea      TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTTTTTGGCTTCA
Iboer        TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCAATCATTGGTAATGTTTTTGGCTTCA
Maripelta    TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCGATCATTGGTAATGTATTTGGATTCA
Cordyle      TTGAAGAAGGATCTATAGCAAACTTAACAGCTTCGATCATTGGTAATGTATTTGGATTCA
Halichrysis  NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN


Chamaebot232 AAGCAGTTAAAGCTTTGAGACTAGAAGATATGCGCATTCCAGTAGCTTATCTGAAAACTT
Chamaebot231 AAGCAGTTAAAGCTTTGAGACTAGAAGATATGCGCATTCCAGTAGCTTATCTGAAAACTT
Coelclif235  AAGCTGTTAAAGCTTTAAGGTTAGAAGATATGGGTATTCCAGTAGCTTACTTAAAAACTT
C.parvula198 AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATACCTGTTGCTTATTTAAAAACTT
C.parvula173 AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATACCTGTTGCTTATTTAAAAACTT
Chacompressa AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGAATACCTGTTGCTTACTTAAAAACTT
Champia214N  AAGCAGTTAAAGCTTTGAGATTAGAAGATATGCGTATACCTGTTGCTTACTTAAAAACTT
Champia214Na AAGCAGTTAAAGCTTTGAGATTAGAAGATATGCGTATACCTGTTGCTTACTTAAAAACTT
Cvieillar221 AAGCAGTAAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTTGCTTATTTAAAAACTT
Cvieillar286 AAGCAGTAAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTTGCTTATTTAAAAACTT
C.harv177    AAGCAGTTAAAGCTCTAAGATTAGAAGATATGCGTATTCCAGTAGCATATTTAAAAACTT
Chharv160    AAGCAGTTAAAGCTATAAGATTAGAAGATATGCGTATTCCAGTAGCATATTTAAAAACTT
Chharv194    AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTAGCATATTTAAAAACTT
C.sali161    AAGCAGTAAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTAGCATATTTAAAAACTT
chsali195    AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTAGCATATTTAAAAACTT
Neogastro    AAGCTGTTAAAGCTTTAAGATTAGAAGATATGCGTCTTCCAGTTGCATATTTAAAAACGT
Neogastro    AAGCTGTTAAAGCTTTAAGATTAGAAGATATGCGTCTTCCAGTTGCATATTTAAAAACGT
Chylocladia  AAGCTGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTTGCTTATTTAAAAACCT
Coelothrix   AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTTGCTTATTTAAAAACTT
Coelo215     AAGCAGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTTGCTTATTTAAAAACTT
Halymenia    AAGCAGTAAAAGCTTTAAGATTAGAAGATATGCGTATACCTGTAGCTTATCTTAAAACTT
Lhako        AAGCCGTAAAAGCTTTAAGACTTGAAGATATGCGTCTTCCTATAGCTTATCTAAAAACTT
Lhako        AAGCCGTAAAAGCTTTAAGACTTGAAGATATGCGTCTTCCTATAGCTTATCTAAAAACTT
Ceratodicti  AAGCTGTAAAAGCTTTAAGATTGGAAGACATGCGTATTCCAGTAGCTTATCTAAAAACAT
Cerato       AAGCTGTAAAAGCTTTAAGATTGGAAGACATGCGTATTCCAGTAGCTTATCTAAAAACAT
Lcatenata    AAGCTGTAAAAGCTCTGAGACTTGAAGATATGCGTATCCCAGTAGCTTACCTGAAAACTT
Gloioc       AAGCTGTTAAAGCTTTAAGATTAGAAGATATGCGTATTCCAGTAGCTTATCTGAAAACTT
Chagardhii   AAGCAGTTAAAGCATTGCGATTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Chprocumbens AAGCTGTAAAAGCTCTAAGGCTGGAAGATATGCGTATACCTGTAGCTTATTTGAAAACAT
Centero143   AAGCAGTTAAAGCACTAAGACTAGAGGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Centero201   AAGCAGTTAAAGCACTAAGACTAGAGGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Botry        AAGC-GTTAAAGCATTAAGG-TAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.caraibica  AAGC-GTTAAAGCATTAAGG-TAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Bocci172     AAGCTGTTAAAGCATTAAGGTTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.occid2     AAGCTGTTAAAGCATTAAGGTTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.pyriformis AAGC-GT-AAAGC--TAAG--TAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.ebriosa    AAGCTGTTAAAGCACTAAGGCTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Bspin        AAGCTGTTAAAGCACTAAGGCTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Bcana        AAGCTGTTAAAGCACTAAGGCTAAAAGATATGCGGATTCCAAAACCTAATCAAAAAACTT
Bskott       AAGCTGTTAAAGCACTAAGGCTAGAAGATATGCGTATTCCAGGAGCTTATCTAAAAACTT
Bpapen       AAGCTGTTAAAGCACTAAGGCTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Botryocladia AAGCTGTTAAAGCACTAAGACTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.botryoides AAGCTGTTAAAGCACTAAGACTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Bmada        AAGCAGTAAAAGCATTAAGATTAGAAGATATGCGAATTCCTGTTGCTTATCTAAAAACTT
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Birri224     AAGCAGTTAAAGCATTAAGATTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.shanskii   AAGCAGTTAAAGCATTAAGACTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.monoica    AAGCAGTTAAAGCACTAAGATTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
B.uvarioides AAGCAGTTAAAGCGCTAAGACTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Rhodymenia   AAGCTGTAAAAGCATTAAGACTAGAAGATATGCGCATCCCAGTTGCTTATCTAAAAACTT
Rhodysp.     AAGCTGTAAAAGCATTAAGACTAGAAGATATGCGCATCCCAGTTGCTTATCTAAAAACTT
Rpseud       AAGCTGTAAAAGCATTAAGACTAGAAGATATGCGCATCCCAGTTGCTTATCTAAAAACTT
Rdiva240     AGGCTGTAAAAGCATTGAGATTAGAAGACATGCGTATTCCAGTTGCTTATCTAAAAACTT
E.capensis   AAGCTGTAAAAGCATTGAGATTAGAGGATATGCGCATCCCAGTTGCTTACCTAAAAACTT
Epymenia     AAGCTGTAAAAGCATTGAGACTAGAGGACATGCGCATCCCAGTTGCTTATCTAAAAACTT
E.wilsonis   AAGCTGTAAAAGCATTAAGATTAGAAGATATGCGCATCCCAGTTGCTTATCTAAAAACTT
Rskott       AAGCTGTAAAAGCATTAAGATTAGAAGACATGCGTATTCCAGTTGCTTATCTAAAAACTT
R.corallina  AAGCTGTAAAAGCATTGAGATTAGAAGATATGCGTATTCCAGTTGCTTATCTAAAAACTT
Cwright      AAGCAGTTAAGGCATTGAGATTAGAAGATATGCGCATTCCGGTAGCTTATCTAAAAACTT
Ch.wrightii  AAGCAGTTAAGGCATTGAGATTAGAAGATATGCGCATTCCGGTAGCTTATCTAAAAACTT
Irvinea      AAGCAGTTAAGGCATTAAGATTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Iboer        AAGCAGTTAAGGCATTAAGATTAGAAGATATGCGTATTCCAGTAGCTTATCTAAAAACTT
Maripelta    AAGCTGTTAAAGCATTAAGACTAGAAGATATGCGCATTCCAGTTGCTTATCTAAAAACTT
Cordyle      AAGCTGTTAAAGCATTAAGACTAGAAGATATGCGCATTCCAGTTGCTTATCTAAAAACTT
Halichrysis  NNNNNNTTAAANNNTTAAGGTTAGAAGANATGGGTATTCCTGTAGCTTATCTGAAAACAT
                   * **     *  *  *  * ** *** *  * **     *  *    ***** *

Chamaebot232 TCCAAGGTCCTGCAACAGGTATTATTGTAGAACGTGAGCGTATGGATAAGTTTGGACGTC
Chamaebot231 TCCAAGGTCCTGCAACAGGTATTATTGTAGAACGTGAGCGTATGGATAAGTTTGGACGTC
Coelclif235  TCCAAGGTCCTGCAACAGGAACTGTTGTAGAACGTGAACGTATGGATAAATTTGGACGCC
C.parvula198 TCCAAGGTCCTGCTACTGGGATTGTTGTAGAGCGTGAGCGTATGGATAAATTTGGTCGCC
C.parvula173 TCCAAGGTCCTGCTACTGGGATTGTTGTAGAGCGTGAGCGTATGGATAAATTTGGTCGCC
Chacompressa TCCAAGGTCCTGCTACTGGGATTGTTGTAGAACGTGAGCGTATGGACAAATTTGGTCGCC
Champia214N  TCCAAGGTCCTGCTACTGGGATTGTTGTAGAGCGTGAGCGTATGGATAAATTTGGTCGTC
Champia214Na TCCAAGGTCCTGCTACTGGGATTGTTGTAGAGCGTGAGCGTATGGATAAATTTGGTCGTC
Cvieillar221 TCCAAGGACCTGCAACTGGAATTGTTGTAGAGCGTGAACGTATGGATAAATTTGGTCGTC
Cvieillar286 TCCAAGGACCTGCAACTGGAATTGTTGTAGAGCGTGAACGTATGGATAAATTTGGTCGTC
C.harv177    TCCAAGGTCCTGCTACAGGCGTCGTTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
Chharv160    TCCAAGGTCCTGCTACAGGCGTCGTTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
Chharv194    TCCAAGGTCCTGCTACAGGCGTCGTTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
C.sali161    TCCAAGGTCCTGCTACAGGCGTCGTTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
chsali195    TCCAAGGTCCTGCTACAGGCGTCGTTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
Neogastro    TCCAAGGTCCCGCAACCGGTATTGTTGTAGAGCGTGAGCAATTGGATAAGTTTGGACGTC
Neogastro    TCCAAGGTCCCGCAACCGGTATTGTTGTAGAGCGTGAGCGNATGGATAAGTTTGGACGTC
Chylocladia  TCCAAGGTCCTGCAACTGGTTTTGTTGTAGAGCGTGAGCAATTGGATAAATTTGGACGTC
Coelothrix   TCCAAGGTCCTGCGACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAATTCGGACGTC
Coelo215     TCCAAGGTCCTGCGACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAATTCGGACGTC
Halymenia    TCCAAGGACCTGCAACTGGAGTCATTGTAGAACGTGAACGTATGGATAAATTTGGTCGTC
Lhako        TCCAAGGACCTGCAACTGGTGTTGTTGTAGAACGCGAACGTATGGATAAATTTGGTAAAC
Lhako        TCCAAGGACCTGCAACTGGTGTTGTTGTAGAACGCGAACGTATGGATAAATTTGGTAAAC
Ceratodicti  TCCAAGGTCCTGCAACAGGAATTGTTGTAGAGCGTGAACGTATGGATAAATTTGGTCGTC
Cerato       TCCAAGGTCCTGCAACAGGAATTGTTGTAGAGCGTGAACGTATGGATAAATTTGGTCGTC
Lcatenata    TCCAAGGCCCTGCAACTGGAGTTGTTGTAGAACGTGAGCGTATGGATAAGTTTGGTCGTC
Glioc        TCCAAGGGCCTGCAACAGGTGTTATTGTAGAACGCGAAAGAATGGATAAGTTTGGACGTC
Chagardhii   TCCAAGGACCTGCAACAGGAGTTATTGTTGAGCGTGAACGTATGGACAAATTTGGACGTC
Chprocumbens TTCAAGGTCCTGCAACAGGTATTGTTGTTGAACGTGAACGCATGGATAAATTTGGACGTC
Centero143   TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAGCGCATGGATAAGTTTGGACGCC
Centero201   TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAGCGCATGGATAAGTTTGGACGCC
Botry        TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTT-GGACGTC
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B.caraibica  TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTT-GGACGTC
Bocci172     TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTTCGGACGTC
B.occid2     TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTTCGGACGTC
B.pyriformis TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGA-CG-ATGGATAA-TT-GG-CGTC
B.ebriosa    TCCAAGGTCCTGCAACAGGAATTGTTGTGGAACGCGAACGCATGGATAAGTTCGGACGTC
Bspin        TCCAAGGTCCTGCAACAGGAATTGTTGTGGAACGCGAACGCATGGATAAGTTCGGACGTC
Bcana        GCCAAGGTCCTGCAACAGAAATTGCTGTGGAACGCGAACGCATGGATAAGTTGGGACGTC
Bskott       TGCAAGGTCCTGCAACAGGAATTGTTGTGGAACGNNANCGNATGGATAANTT-GGGCGTC
Bpapen       TCCGAGGTCCTGCAACAGGAATTGCTGTGGAACCCAAACGCATGGATAAGTTCGGACGTC
Botryocladia TCCAAGGTCCTGCAACAGGAATTGTTGTGGAACGTGAGCGTATGGATAAATTTGGACGTC
B.botryoides TCCAAGGTCCTGCAACAGGAATTGTTGTGGAACGTGAGCGTATGGATAAATTTGGACGTC
Bmada        TCCAAGGACCTGCAACAGGAATCGTTGTAGAACGTGAACGCATGGATAAATTTGGACGTC
Birri224     TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAACGTATGGATAAGTTTGGACGTC
B.shanskii   TCCAGGGTCCTGCAACAGGGATTGTTGTAGAACGTGAGCGTATGGATAAATTTGGACGTC
B.monoica    TCCAGGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTTTGGACGTC
B.uvarioides TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAGCGTATGGATAAGTTTGGACGTC
Rhodymenia   TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAACGTATGGACAAGTTTGGACGTC
Rhodysp.     TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAACGTATGGACAAGTTTGGACGTC
Rpseud       TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAACGTATGGACAAGTTTGGACGTC
Rdiva240     TCCAAGGTCCTGCAACAGGAATCGTTGTAGAGCGTGAGCGTATGGATAAGTTTGGACGTC
E.capensis   TCCAAGGTCCTGCAACAGGAGTTATTGTAGAGCGTGAACGTATGGATAAGTTTGGACGTC
Epymenia     TCCAAGGTCCTGCAACAGGAGTTATTGTAGAGCGTGAACGTATGGATAAGTTTGGACGTC
E.wilsonis   TCCAAGGTCCTGCAACAGGAGTTATTGTAGAGCGTGAACGTATGGATAAGTTTGGACGTC
Rskott       TCCAAGGTCCTGCAACAGGAGTTGTTGTAGAGCGTGAACGCATGGATAAGTTTGGACGTC
R.corallina  TCCAAGGTCCTGCAACAGGAGTTGTTGTAGAGCGTGAGCGCATGGATAAGTTTGGACGTC
Cwright      TCCAAGGTCCTGCAACAGGAGTTGTTGTAGAGCGTGAGCGCATGGATAAGTTTGGACGTC
Ch.wrightii  TCCAAGGTCCTGCAACAGGAGTTGTTGTAGAGCGTGAGCGCATGGATAAGTTTGGACGTC
Irvinea      TCCAAGGTCCTGCAACAGGTATCGTTGTAGAGCGTGAACGTATGGATAAATTTGGACGTC
Iboer        TCCAAGGTCCTGCAACAGGTATCGTTGTAGAGCGTGAACGTATGGATAAATTTGGACGTC
Maripelta    TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAACGCATGGATAAATTTGGACGTC
Cordyle      TCCAAGGTCCTGCAACAGGAATTGTTGTAGAACGTGAACGCATGGATAAATTTGGACGTC
Halichrysis  TTCAAGGTCCTGCAACAGGAGTTGTTGTAGAGCGTGAACGTATGGATAAATTTGGACGCC
               *  ** ** ** ** *       *** ** *   *     **** ** ** **    *

Chamaebot232 CTTTCTTAGGTGCAACGGTAAAACCTAAACTAGGTTTATCTGGTAAAAACTACGGAAGAG
Chamaebot231 CTTTCTTAGGTGCAACGGTAAAACCTAAACTAGGTTTATCTGGTAAAAACTACGGAAGAG
Coelclif235  CTTTTTTGGGTGCAACTGTAAAACCAAAATTAGGTTTTTCTGGTAAAAATTACGGAAGGG
C.parvula198 CTTTCTTAGGAGCTACAGTAAAACCTAAATTAGGTCTTTCAGGTAAAAATTATGGTAGAG
C.parvula173 CTTTCTTAGGAGCTACAGTAAAACCTAAATTAGGTCTTTCAGGTAAAAATTATGGTAGAG
Chacompressa CTTTCTTAGGAGCTACAGTAAAACCTAAATTAGGTCTTTCAGGTAAAAATTATGGTAGAG
Champia214N  CTTTCTTAGGAGCTACAGTAAAACCTAAATTAGGTCTTTCAGGTAAAAATTATGGTAGAG
Champia214Na CTTTCTTAGGAGCTACAGTAAAACCTAAATTAGGTCTTTCAGGTAAAAATTATGGTAGAG
Cvieillar221 CTTTCTTAGGAGCTACTGTAAAACCTAAATTAGGTCTTTCAGGAAAAAATTATGGAAGAG
Cvieillar286 CTTTCTTAGGAGCTACTGTAAAACCTAAATTAGGTCTTTCAGGAAAAAATTATGGAAGAG
C.harv177    CTTTCTTAGGAGCAACTGTAAAACCTAAGTTAGGTCTTTCGGGTAAAAACTATGGAAGAG
Chharv160    CTTTCTTAGGAGCAACTGTAAAACCTAAGTTAGGTCTTTCGGGTAAAAACTATGGAAGAG
Chharv194    CTTTCTTAGGAGCAACTGTAAAACCTAAGTTAGGTCTTTCGGGTAAAAACTATGGAAGAG
C.sali161    CTTTCTTAGGTGCAACTGTAAAACCTAAGTTAGGTCTTTCGGGTAAAAACTATGGAAGAG
chsali195    CTTTCTTAGGTGCAACTGTAAAACCTAAGTTAGGTCTTTCGGGTAAAAACTATGGAAGAG
Neogastro    CTTTTTTAGGAGCTACTGTAAAGCCTAAATTAGGTCTTTCTGGTAAAAACTATGGTAGAG
Neogastro    CTTTTTTAGGAGCTACTGTAAAGCCTAAATTAGGTCTTTCTGGTAAAAACTATGGTAGAG
Chylocladia  CTTTCTTAGGAGCTACTGTAAAGCCTAAATTAGGTCTTTCCGGTAAAAACTATGGTAGAG
Coelothrix   CTTTTTTAGGGGCAACAGTAAAACCTAAACTAGGCCTTTCTGGTAAAAACTATGGAAGAG
Coelo215     CTTTTTTAGGGGCAACAGTAAAACCTAAACTAGGCCTTTCTGGTAAAAACTATGGAAGAG
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Halymenia    CATTTCTAGGTGCAACTGTTAAGCCTAAATTAGGTCTATCAGGCAAAAATTATGGTAGAG
Lhako        CTTTCCTTGGTGCAACTGTAAAACCTAAATTAGGTTTATCCGGTAAAAACTATGGTAGAG
Lhako        CTTTCCTTGGTGCAACTGTAAAACCTAAATTAGGTTTATCCGGTAAAAACTATGGTAGAG
Ceratodicti  CTTTCTTAGGTGCAACTGTAAAACCTAAGCTAGGTCTATCTGGTAAAAATTACGGTAGAG
Cerato       CTTTCTTAGGTGCAACTGTAAAACCTAAGCTAGGTCTATCTGGTAAAAATTACGGTAGAG
Lcatenata    CTTTCTTAGGTGCAACTGTAAAACCTAAATTAGGTCTATCTGGTAAAAACTATGGTAGAG
Glovoc       CTTTCCTAGGTGCCACTGTAAAACCAAAATTAGGTCTTTCTGGAAAAAACTACGGAAGAG
Chagardhii   CTTTCTTAGGTGCAACTGTAAAACCTAAGCTGGGTCTTTCTGGTAAAAATTACGGAAGGG
Chprocumbens CTTTCCTAGGTGCAACCGTTAAGCCAAAGCTAGGGTTATCTGGCAAAAACTATGGCAGAG
Centero143   CTTTCTTAGGTGCAACTGTAAAACCTAAACTAGGTCTTTCTGGTAAAAACTACGGAAGAG
Centero201   CTTTCTTAGGTGCAACTGTAAAACCTAAACTAGGTCTTTCTGGTAAAAACTACGGAAGAG
Botry        CTTTCTT-GG-GCAAC-GTAAAGCCTAAG-TAGGTCTTTCTGG-AAAAACTA-GGA-G-G
B.caraibica  CTTTCTT-AG-GCAAC-GTAAAGCCTAAG-TAGGTCTTTCTGG-AAAAACTA-GGA-G-G
Bocci172     CTTTCTTAGGTGCAACTGTAAAGCCTAAGCTAGGTCTTTCTGGTAAAAACTACGGAAGAG
B.occid2     CTTTCTTAGGTGCAACTGTAAAGCCTAAGCTAGGTCTTTCTGGTAAAAACTACGGAAGAG
B.pyriformis CTTT-TT--G-GCAAC-GTAAAGCC-AA--TAGGTCT-TCTGG-AAAAA-TA-GG--G-G
B.ebriosa    CTTTCTTAGGCGCAACTGTAAAGCCGAAGCTAGGTCTCTCTGGNAAAAACTACGGAAGGG
Bspin        CTTTCTTAGGCGCAACTGTAAAGCCGAAGCTAGGTCTTTCTGGTAAAAACTACGGAAGGG
Bcana        CTTTCTTAGGCGCAACTGTAAAGCCGAAGCTAGGTCTTTCTGGTAAAAACTACGGAAGGG
Bskott       CNTTNNTNGGNGCAACTGTAAANCCNAANNTAGGTNTNTCNGGNAAAAACTANGGANGNG
Bpapen       CTTTCTTATGCGCAACTGTGAAGCCGAAACTGGGTCTTTCCGGTAAAGACTACGCATGGT
Botryocladia CTTTCTTAGGTGCAACTGTAAAGCCGAAGCTAGGTCTTTCTGGCAAAAACTACGGAAGGG
B.botryoides CTTTCTTAGGTGCAACTGTAAAGCCGAAGCTAGGTCTTTCTGGCAAAAACTACGGAAGGG
Bmada        CATTTTTAGGTGCAACTGTAAAACCTAAACTAGGTTTATCAGGTAAAAACTATGGACGTG
Birri224     CTTTCTTAGGAGCAACTGTAAAACCTAAACTAGGTCTTTCTGGCAAAAACTACGGAAGAG
B.shanskii   CTTTCTTGGGTGCAACTGTAAAGCCTAAACTAGGTCTTTCTGGCAAAAACTATGGACGAG
B.monoica    CTTTCCTAGGTGCAACTGTAAAACCTAAGCTAGGTCTTTCTGGTAAAAACTACGGAAGAG
B.uvarioides CTTTCTTGGGTGCAACCGTAAAACCTAAATTAGGTCTTTCTGGTAAAAACTATGGACGAG
Rhodymenia   CTTTCTTGGGTGCAACTGTAAAACCTAAGCTAGGTCTTTCTGGTAAAAACTATGGAAGAG
Rhodysp.     CTTTCTTGGGTGCAACTGTAAAACCTAAGCTAGGTCTTTCTGGTAAAAACTATGGAAGAG
Rpseud       CTTTCTTGGGTGCAACTGTAAAACCTAAGCTAGGTCTTTCTGGTAAAAACTATGGAAGAG
Rdiva240     CTTTCTTAGGCGCAACTGTAAAACCTAAATTAGGTTTTTCTGGTAAAAACTATGGAAGAG
E.capensis   CTTTCTTGGGCGCAACTGTAAAACCTAAACTAGGTCTTTCTGGCAAAAACTACGGAAGAG
Epymenia     CTTTCTTGGGCGCAACTGTAAAACCTAAACTAGGTCTTTCTGGCAAAAACTACGGAAGAG
E.wilsonis   CTTTCTTGGGCGCAACTGTAAAACCTAAATTAGGTCTTTCTGGTAAAAACTATGGAAGAG
Rskott       CTTTTTTAGGTGCAACTGTAAAACCTAAGCTAGGCCTTTCTGGTAAAAACTATGGAAGAG
R.corallina  CTTTCTTAGGCGCAACTGTAAAACCTAAATTAGGTCTTTCTGGTAAAAACTACGGAAGAG
Cwright      CTTTTTTAGGCGCAACTGTAAAACCTAAGTTAGGTCTTTCTGGTAAGAACTATGGACGAG
Ch.wrightii  CTTTTTTAGGCGCAACTGTAAAACCTAAGTTAGGTCTTTCTGGTAAGAACTATGGACGAG
Irvinea      CTTTTCTGGGTGCAACTGTAAAGCCTAAATTAGGTCTATCTGGTAAAAACTATGGAAGAG
Iboer        CTTTTCTGGGTGCAACTGTAAAGCCTAAATTAGGTCTATCTGGNAAAAACTATGGAAGAG
Maripelta    CTTTCTTGGGTGCAACTGTAAAACCTAAGCTAGGTCTTTCTGGCAAAAACTACGGAAGAG
Cordyle      CTTTCTTGGGTGCAACTGTAAAACCTCAGCTAGGTCTTTCTGGCAAAAACTCCGGAAGGG
Halichrysis  CTTTTTTAGGAGCAACTGTAAAACCAAAATTAGGTCTTTCTGGTAAAAACTATGGTAGAG
             * **  *  * ** ** ** ** **  *  * **  * ** ** **  * *  *   *

Chamaebot232 TAGTTTATGAAGGCCTGAAAGGTGGATTAGATTTTCTGAAAGACGATGAAAATATTAATT
Chamaebot231 TAGTTTATGAAGGCCTGAAAGGTGGATTAGATTTTCTGAAAGACGATGAAAATATTAATT
Coelclif235  TGTTTTATGAAGGCCTAAAGGCTGGCTTGGACTTCTTGAAGAATGATGAAAATTTTAATT
C.parvula198 TAGTTTATGAAGGTCTTAAAGGTGGATTAGATTTTCTAAAAGATGATGAGAATATTAACT
C.parvula173 TAGTTTATGAAGGTCTTAAAGGTGGATTAGATTTTCTAAAAGATGATGAGAATATTAACT
Chacompressa TAGTTTACGAAGGTCTTAAAGGTGGATTAGATTTTCTAAAAGATGATGAGAATATCAACT
Champia214N  TAGTTTATGAAGGTCTTAAAGGTGGATTAGATTTTCTAAAAGATGATGAAAATATTAACT
Champia214Na TAGTTTATGAAGGTCTTAAAGGTGGATTAGATTTTCTAAAAGATGATGAAAATATTAACT
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Cvieillar221 TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTTCTAAAAGATGATGAAAATATTAACT
Cvieillar286 TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTTCTAAAAGATGATGAAAATATTAACT
C.harv177    TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTCCTAAAAGATGATGAGAATATTAATT
Chharv160    TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTCCTAAAAGATGATGAGAATATTAATT
Chharv194    TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTCCTAAAAGATGATGAGAATATTAATT
C.sali161    TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTCCTAAAAGATGATGAGAATATTAATT
chsali195    TAGTTTATGAAGGTCTTAAAGGTGGTCTAGATTTCCTAAAAGATGATGAGAATATTAATT
Neogastro    TAGTTTATGAAGGTCTTAAAGGTGGTTTAGATTTTCTAAAAGATGATGAGAATATTAACT
Neogastro    TAGTTTATGAAGGTCTTAAAGGTGGTTTAGATTTTCTAAAAGATGATGAGAATATTAACT
Chylocladia  TAGTTTATGAAGGTTTTAAAGGTGGTTTAGATTTTCTAAAAGATGATTGGAATATTAACC
Coelothrix   TAGTATATGAAGGCCTTAAAGGTGGTTTAGACTTTCTTAAAGATGATGAGAATATAAATT
Coelo215     TAGTATATGAAGGCCTTAAAGGTGGTTTAGACTTTCTTAAAGATGATGAGAATATAAATT
Halymenia    TAGTATATGAAGGTCTTAAAGGTGGCCTAGATTTCCTTAAAGATGATGAGAATATTAACT
Lhako        TAGTTTATGAAGGTTTAAAAGGTGGATTAGATTTCTTAAAAGATGATGAAAATATTAATT
Lhako        TAGTTTATGAAGGTTTAAAAGGTGGATTAGATTTCTTAAAAGATGATGAAAATATTAATT
Ceratodicti  TAGTTTATGAGGGTTTAAAAGGTGGATTAGATTTTCTGAAAGATGATGAAAATATCAATT
Cerato       TAGTTTATGAGGGTTTAAAAGGTGGATTAGATTTTCTGAAAGATGATGAAAATATCAATT
Lcatenata    TAGTTTACGAGGGTTTAAGAGGTGGATTAGATTTCCTAAAAGATGATGAGAATATTAATT
Gloioc       TAGTCTATGAAGGTCTTAGAGGTGGTTTAGATTTTCTGAAAGATGATGAGAATATTAATT
Chagardhii   TAGTATACGAAGGTCTAAAAGGTGGCTTAGATTTCTTGAAGGATAATGAAAATATTAACT
Chprocumbens TAGTCTACGAGGGACTTAAAGGTGGTTTAGATTTTCTTAAAGATGATGAAAATATTAACT
Centero143   TAGTTTATGAAGGCTTAAAAGGTGGTCTAGATTTTCTTAAGGATGACGAAAATATTAACT
Centero201   TAGTTTATGAAGGCTTAAAAGGTGGTCTAGATTTTCTTAAGGATGACGAAAATATTAACT
Botry        TAGTTTA-GAAGG--T-AAAGG-GGACTAGACTTCCTGAAAGATGACGAAAACATCAATT
B.caraibica  TAGTTTA-GAAGG--T-AAAGG-GGACTAGACTTCCTGAAAGATGACGAAAACATCAATT
Bocci172     TAGTTTATGAAGGCTTAAAGGGTGGACTAGACTTCCTGAAAGATGACGAAAATATTAACT
B.occid2     TAGTTTATGAAGGCTTAAAGGGTGGACTAGACTTCCTGAAAGATGACGAAAATATTAACT
B.pyriformis TAGTTTA-GAAGG--T-AAAGG-GGA-TAGACTTCCTGAAAGATGATGAGAATATTAACT
B.ebriosa    TAGTTTATGAAGGTCTAAAAGGTGGACTAGACTTCTTGAAAGATGATGAAAATATTAACT
Bspin        TAGTTTATGAAGGACTAAAAGGTGGACTAGACTTCTTGAAAGATGATGAAAATATTAACT
Bcana        TAGTTTATGAAGGTCTAAAAGGTGGACTAGACTTCTTGAAAGATGATGAAAATATTAACT
Bskott       TNGTTTA-GAAGGNNTNAAAGGNGGNNTNGACTTNNTNAAAGATGANGANAANATNAACT
Bpapen       TGGTTTATCAAGGNNTNAAAGGNGGNNTNGACTTNNTNAAAGATGANGANAANATNAANT
Botryocladia TGGTTTATGAAGGTCTAAAAGGTGGACTAGACTTCTTGAAAGATGACGAAAATATTAACT
B.botryoides TGGTTTATGAAGGTCTAAAAGGTGGACTAGACTTCTTGAAAGATGACGAAAATATTAACT
Bmada        TAGTTTATGAAGGTCTTAAAGGTGGTTTAGACTTCTTGAAAGATGACGAAAATATTAACT
Birri224     TAGTTTATGAAGGTCTAAAAGGTGGATTAGACTTCCTGAAAGATGATGAAAATATTAACT
B.shanskii   TAGTTTACGAAGGTCTAAAAGGTGGACTAGACTTCTTGAAAGATGACGAAAACATTAACT
B.monoica    TAGTTTACGAAGGTCTAAAAGGTGGTCTAGACTTCCTAAAAGACGACGAAAACATCAACT
B.uvarioides TAGTTTATGAAGGTCTAAAAGGTGGATTAGACTTCTTGAAAGATGATGAAAACATCAACT
Rhodymenia   TAGTTTACGAAGGGTTAAAAGGTGGCCTAGACTTCTTGAAGGATGATGAAAATATTAATT
Rhodysp.     TAGTTTACGAAGGGTTAAAAGGTGGCCTAGACTTCTTGAAGGATGATGAAAATATTAATT
Rpseud       TAGTTTACGAAGGTTTAAAAGGTGGACTAGACTTCTTGAAAGATGATGAAAATATTAATT
Rdiva240     TAGTTTATGAAGGTTTTAAAGGTGGACTAGACTTCTTGAAAGATGATGAGAATATTAACT
E.capensis   TAGTTTATGAAGGCCTAAAAGGTGGATTAGACTTCTTGAAGGATGATGAAAATATTAACT
Epymenia     TAGTTTATGAAGGCCTAAAAGGTGGATTAGACTTCTTGAAGGATGATGAAAATATCAACT
E.wilsonis   TAGTTTATGAAGGCTTAAAAGGTGGATTAGACTTCTTGAAAGATGATGAAAATATTAACT
Rskott       TAGTTTATGAAGGCTTGAAAGGTGGGTTAGACTTCTTGAAGGATGATGAGAATATTAACT
R.corallina  TAGTTTATGAAGGTTTAAAAGGTGGATTAGACTTCTTGAAGGATGATGAAAATATCAACT
Cwright      TAGTTTATGAAGGCTTGAAAGGTGGATTAGACTTTTTGAAAGATGATGAGAATATTAATT
Ch.wrightii  TAGTTTATGAAGGCTTGAAAGGTGGATTAGACTTTTTGAAAGATGATGAGAATATTAATT
Irvinea      TAGTTTATGAAGGCCTTAAAGGCGGATTGGACTTTCTGAAAGATGATGAAAACATCAACT
Iboer        TAGTTTATGAAGGCCTTAAAGGCGGATTGGACTTTCTGAAAGACCATGAAAACATCAACT
Maripelta    TAGTTTATGARGGCTTAAAAGGCGGTCTAGACTTCTTRAAAGATGATGAAAACATTAACT
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Cordyle      TGTTTCATGAAGGTCNCAAGGCCGGACTAGNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
Halichrysis  TAGTATATGAAGGCCTAAGAGGTGGTCTAGANNNNNNNNNNNNNNNNNNNNNNNNNNNNN
             *  *  *  * **    *  *  **  * *

Chamaebot232 CTCAGCCTTTTATGCGTTGGAAGGAACGATTCTTGTATTCAATGGAAGCCGTTAACCGTT
Chamaebot231 CTCAGCCTTTTATGCGTTGGAAGGAACGATTCTTGTATTCAATGGAAGCCGTTAACCGTT
Coelclif235  CTCAGCCTTTCATGCGTTGGAAGGAAGGATTCTTATATTCAATGGAGGCGGTTAACCGTC
C.parvula198 CTCAGCCTTTCATGAGATGGAAAGAAAGATTCTTATACTCAATGGAAGCAGTTAATCGTT
C.parvula173 CTCAGCCTTTCATGAGATGGAAAGAAAGATTCTTATACTCAATGGAAGCAGTTAATCGTT
Chacompressa CTCAACCTTTCATGAGATGGAAAGAAAGATTCCTATACTCAATGGAAGCAGTAAATCGTT
Champia214N  CTCACCCTTTCATGAGATGGAAAGAAAGATTCTTATACTCAATGGAAGCAGTTAATCGTT
Champia214Na CTCACCCTTTCATGAGATGGAAAGAAAGATTCTTATACTCAATGGAAGCAGTTAATCGTT
Cvieillar221 CTCAACCTTTTATGAGATGGAAAGAAAGATTTTTATATTCAATGGAAGCAGTTAATCGTT
Cvieillar286 CTCAGCCTTTTATGAGATGGAAAGAAAGATTTTTATATTCAATGGAAGCAGTTAATCGTT
C.harv177    CTCAACCTTTTATGAGATGGAAAGAGAGATTTTTATATTCAATGGAAGCAGTAAATCGTT
Chharv160    CTCAACCTTTTATGAGATGGAAAGAGAGATTTTTATATTCAATGGAAGCAGTAAATCGTT
Chharv194    CTCAACCTTTTATGAGATGGAAAGAGAGATTTTTATATTCAATGGAAGCAGTAAATCGTT
C.sali161    CTCAACCTTTTATGAGATGGAAAGAGAGATTTTTATATTCAATGGAAGCAGTTAATCGTT
chsali195    CTCAACCTTTTATGAGATGGAAAGAGAGATTTTTATATTCAATGGAAGCAGTTAATCGTT
Neogastro    CTCAACCATTTATGAGATGGAAAGAACGATTTCTATACTCTATGGAAGCTGTTAATCGTT
Neogastro    CTCAACCATTTATGAGATGGAAAGAACGATTTCTATACTCTATGGAAGCTGTTAATCGTT
Chylocladia  CCCAACCTTTTATGAGATGGAAAGAAAGATTTGTATACTCTSTGGAAGCTGTCAATCGTT
Coelothrix   CTCAGCCATTTATGAGATGGAAGGAAAGATTTTTATATTCTATGGAAGCTGTTAATCGCT
Coelo215     CTCAGCCATTTATGAGATGGAAGGAAAGATTTTTATATTCTATGGAAGCTGTTAATCGCT
Halymenia    CTCAGCCTTTCATGCGTTGGAAAGAAAGATTCTTATATTCAATGGAAGGTGTAAACCGTG
Lhako        CACAACCTTTCATGAGATGGAAAGAAAGATTTTTATACTCTATGGAAGCTGTAAACCGTT
Lhako        CACAACCTTTCATGAGATGGAAAGAAAGATTTTTATACTCTATGGAAGCTGTAAACCGTT
Ceratodicti  CACAACCTTTTATGCGTTGGAAAGAAAGATTTTTATATTCAATGGAAGCTGTAAATCGTT
Cerato       CACAACCTTTTATGCGTTGGAAAGAAAGATTTTTATATTCAATGGAAGCTGTAAATCGTT
Lcatenata    CACAGCCTTTCATGCGTTGGAAAGAAAGATTCTTATACTCAATGGAAGCCGTAAACCGTT
Glioc        CACAACCATTTATGCGTTGGAAAGAAAGATTCTTATATTCAATGGAAGCTGTAAATCGTT
Chagardhii   CTCAGCCTTTCATGCGTTGGAAAAAAAGATTTCTTTACTCAATGGAAGCTGTTAACCGTT
Chprocumbens CTCAGCCTTTTATGCGTTGGAAAGAAAGATTTTTATATTCAATGGAAGC-GTGAATCGTT
Centero143   CTCAGCCTTTCATGCGTTGGAAAGAAAGATTCCTATACTCAATGGAGGCTGTTAACCGTT
Centero201   CTCAGCCTTTCATGCGTTGGAAAGAAAGATTCCTATACTCAATGGAGGCTGTTAACCGTT
Botry        CTCAGCCTTTCATGCGTTGGAAAGAAAGATTTTTATACTCAATGGAAGCTGTTAACCGCT
B.caraibica  CTCAGCCTTTCATGCGTTGGAAAGAAAGATTTTTATACTCAATGGAAGCTGTTAACCGCT
Bocci172     CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTGTACTCAATGGAAGCGGTTAACCGTT
B.occid2     CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTGTACTCAATGGAAGCGGTTAACCGTT
B.pyriformis CTCAGCCTTTCATGCGCTGGAAAGAAAGATTCTTATACTCAATGGAAGCTGTTAACCGTT
B.ebriosa    CTCAGCCCTTCATGCGCTGGAAAGAGAGATTTCTGTACTCAATGCAAGCNGTTAACCGCC
Bspin        CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTCTGTACTCAATGGAAGCTGTTAACCGTT
Bcana        CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTCTGTACTCAATGGAAGCTGTTAACCGTT
Bskott       CTCAGCCTTTCATGCGNTGGAAAGANAGATTNNTNTACTCAATGGAAGC-GTTAACCGNN
Bpapen       CTCAGCCTTTNATGCGNTGGAAAGANAGATTNNTNTACTCAATGGAAGCNGTTAACCGNN
Botryocladia CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTTTGTACTCAATGGAGGCTGTTAACCGCT
B.botryoides CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTTTGTACTCAATGGAGGCTGTTAACCGCT
Bmada        CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTTTGTACTCAATGGAAGCTGTTAACCGCT
Birri224     CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTGTACTCAATGGAGGCTGTTAACCGTT
B.shanskii   CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTGTACTCAATGGAAGCTGTTAACCGTT
B.monoica    CTCAGCCTTTCATGCGCTGGAAAGAAAGATTCTTATACTCAATGGAAGCTGTTAACCGCT
B.uvarioides CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTCTGTACTCAATGGAAGCTGTTAACCGTT
Rhodymenia   CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
Rhodysp.     CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
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Rpseud       CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
Rdiva240     CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
E.capensis   CTCAGCCTTTTATGCGCTGGAAAGAAAGATTTTTATATTCAATGGAAGCAGTTAATCGTT
Epymenia     CTCAACCTTTTATGCGTTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
E.wilsonis   CTCAGCCTTTTATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
Rskott       CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTCTATACTCAATGGAAGCAGTTAATCGTT
R.corallina  CTCAGCCTTTCATGCGCTGGAAAGAAAGATTTTTATACTCAATGGAAGCAGTTAATCGTT
Cwright      CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTCTTTACTCGATGGAAGCCGTTAATCGTT
Ch.wrightii  CTCAGCCTTTCATGCGCTGGAAAGAGAGATTTCTTTACTCGATGGAAGCCGTTAATCGTT
Irvinea      CTCAGCCTTTTATGCGTTGGAAAGAAAGATTTCTTTACTCGATGGAAGCTGTTAACCGCT
Iboer        CTCAGCCTTTTATGCGTTGGAAAGAAAGATTTCTTTACTCGATGGAAGCTGTTAACCGCT
Maripelta    CTCAGCCTTTCATGCGTTGGAAAGAAAGGTTTCTTTACGCAATGGAGGCTGTGAACCGCT
Cordyle      NNNNNNNNNNNNNNNGTTGNAAAGAAGGATTTTNNTATTCAATGGAAGCAGTTANGCGTT
Halichrysis  NNNNNNNNNNNNNNNNNTGGAAGGAAAGGTTCTTATATTCGATGGAAGCCGTCAATCGTT
                              ** **  *  * **    **  *  ** * *  ** *  **

Chamaebot232 CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGGTACAATGG
Chamaebot231 CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGGTACAATGG
Coelclif235  CAATAGCAGCTACGGGTGAAGTTAAAGGTCATTACATGAATGTTCATGCTGCTACAATGG
C.parvula198 CAATTGCAGCAACAGGGGAAGTTAAAGGACATTATATGAATGTTACTGCTTCTACTATGG
C.parvula173 CAATTGCAGCAACAGGTGAAGTTAAAGGACATTATATGAATGTTACTGCTTCTACTATGG
Chacompressa CAATTGCAGCAACAGGTGAAGTGAAAGGACATTATATGAATGTTACTGCTTCTACTATGG
Champia214N  CAATTGCAGCTACAGGTGAAGTTAAAGGGCATTACATGAATGTTTCTGCTTCTACTATGG
Champia214Na CAATTGCAGCTACAGGTGAAGTTAAAGGGCATTACATGAATGTTTCTGCTTCTACTATGG
Cvieillar221 CAATTGCAGCAACTGGCGAAGTAAAAGGCCATTATATGAATGTTACAGCTTCTACCATGG
Cvieillar286 CAATTGCAGCAACTGGCGAAGTAAAAGGTCATTATATGAATGTTACAGCTTCTACCATGG
C.harv177    CGATTGCAGCGACTGGCGAAGTTAAAGGTCATTACATGAATGTTACAGCTTCTACAATGG
Chharv160    CGATTGCAGCGACTGGAGAAGTTAAAGGTCATTACATGAATGTTACAGCTTCTACAATGG
Chharv194    CGATTGCAGCGACTGGTGAAGTTAAAGGTCATTACATGAATGTTACAGCTTCTACAATGG
C.sali161    CGATTGCAGCGACTGGCGAAGTTAAAGGTCATTACATGAATGTTACAGCTTCTACAATGG
chsali195    CGATTGCAGCGACTGGCGAAGTTAAAGGTCATTACATGAATGTTACAGCTTCTTCAATGG
Neogastro    CAATTGCAGCGACAGGAGAAGTAAAAGGTCATTACATGAATATTACGGCTGCAACCATGG
Neogastro    CAATTGCAGCGACAGGAGAAGTAAAAGGTCATTACATGAATATTACGGCTGCAACCATGG
Chylocladia  CAATTGCAGCGACAGGAGAAGTTAAAGGCCATTACATGAACTTTACAGCTGCCACGATGG
Coelothrix   CAATTGCAGCTACTGGAGAAGTAAAAGGCCATTATATGAACGTGACGGCGTCTACAATGG
Coelo215     CAATTGCAGCTACTGGAGAAGTAAAAGGCCATTATATGAACGTGACGGCGTCTACAATGG
Halymenia    CAATAGCGGCTAGCGGTGAAGTTAAAGGTCACTATATGAATGTTACTGCAGCTACAATAG
Lhako        CTATTGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACAGCTGCTACAATGG
Lhako        CTATTGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACAGCTGCTACAATGG
Ceratodicti  CAATTGCAGCTACTGGTGAAGTTAAAGGTCATTACATGAACGTTACTGCAGCTACAATGG
Cerato       CAATTGCAGCTACTGGTGAAGTTAAAGGTCATTACATGAACGTTACTGCAGCTACAATGG
Lcatenata    CAATTGCTGCTACAGGTGAAGTTAAAGGTCACTACATGAATATTACTGCAGCTACAATGG
Glioc        CAATAGCAGCTACGGGTGAAGTGAAAGGTCACTACATGAATGTTACAGCTGCTACGATGG
Chagardhii   CAATAGCGGCTACAGGGGAAGTTAAGGGTCACTATATGAATGTTACATCTGCTACAATGG
Chprocumbens CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACCGCTGCTACAATGG
Centero143   CAATCGCATCTACGGGTGAAGTTAAAGGTCACTACATGAATGTCACTGCGGCTACAATGG
Centero201   CAATTGCATCTACCGGTGAAGTTAAAGGTCACTACATGAATGTCACTGCGGCTACAATGG
Botry        CAATAGCATCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTACAATAG
B.caraibica  CAATAGCATCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTACAATAG
Bocci172     CAATCGCAGCTACCGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTAAAATGG
B.occid2     CAATCGCAGCTACCGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTACAATGG
B.pyriformis CAATAGCAGCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTACAATGG
B.ebriosa    CAATAGCACCTACTGGGGAAGTTAAAGGCCATTACATGAATGTTACTGCTGCTACAATGG
Bspin        CAATAGCAGCTACTGGTGAAGTTAAAGGCCATTACATGAATGTTACTGCTGCTACAATGG
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Bcana        CAATAGCAGCTACTGGTGAAGTTAAAGGCCATTACATGAATGTTACTGCTGCTACAATGG
Bskott       CAATAGCAGCTACNGGNGAAGTTAAAGGNCANTACNTGAATGTTACTGCTGCTACAATGG
Bpapen       CAATAGCAGCTACNGGNGAAGTTAAAGGNCANTACCTGAATGTTACTGCTGCTACAATGG
Botryocladia CAATAGCAGCTACTGGTGAAGTTAAAGGCCACTACATGAATGTTACTGCTGCTACAATGG
B.botryoides CAATAGCAGCTACTGGTGAAGTTAAAGGCCACTACATGAATGTTACTGCTGCTACAATGG
Bmada        CAATAGCAGCTACTGGTGAAGTTAAAGGCCACTACATGAATGTTACTGCTGCTACAATGG
Birri224     CAATAGCAGCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCTACAATGG
B.shanskii   CAATAGCGTCTACTGGTGAAGTTAAAGGTCACTATATGAACGTTACTGCTGCTACAATGG
B.monoica    CAATAGCATCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCAGCTACAATGG
B.uvarioides CAATAGCGTCTACTGGCGAAGTTAAAGGTCATTACATGAACGTTACTGCTGCTACAATGG
Rhodymenia   CAATAGCAGCTACAGGCGAAGTGAAAGGTCATTACATGAATGTTACAGCTGCTACAATGG
Rhodysp.     CAATAGCAGCTACAGGCGAAGTGAAAGGTCATTACATGAATGTTACAGCTGCTACAATGG
Rpseud       CAATAGCAGCTACAGGCGAAGTGAAAGGTCATTACATGAATGTTACAGCTGCTACAATGG
Rdiva240     CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAATGTTACAGCTGCTACAATGG
E.capensis   CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAACGTTACAGCTGCTACAATGG
Epymenia     CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAACGTTACAGCTGCTACAATGG
E.wilsonis   CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTATATGAATGTTACAGCTGCTACAATGG
Rskott       CAATAGCAGCTACGGGTGAAGTTAAAGGTCACTATATGAACATTACAGCGGCTACAATGG
R.corallina  CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTACATGAACGTTACAGCTGCTACAATGG
Cwright      CAATAGCATCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCCACAATGG
Ch.wrightii  CAATAGCATCTACTGGTGAAGTTAAAGGTCACTACATGAATGTTACTGCTGCCACAATGG
Irvinea      CAATAGCAGCTACAGANGAAGTTAAAGGTCATTACCTGAATGTTACTGCNGCTACAATGG
Iboer        CAATAGCAGCTACAGANGAAGTTAAAGGTCATTACCTGAATGTTACTGCNGCTACAATGG
Maripelta    CAATAGCTGCAACAGGCGAAGTAAAAGGTCACTACATGAATGTTACTGCTGCTACAATGG
Cordyle      CAATAGCAGCTACGGTGGAAGTTAAAGGTCACTACATGAACGTTACAGCTGGTACAATGG
Halichrysis  CAATAGCAGCTACAGGTGAAGTTAAAGGTCACTATATGAACGTTACTGCTGCAACAATGG
             * ** **  * *  *  ***** ** ** ** **  ****  *     *       ** *

Chamaebot232 AAAATATGTACGAGAGGGCCGAGTTTGCTAAGCAGTTAGGAACCGTTATTATCATGATTG
Chamaebot231 AAAATATGTACGAGAGGGCCGAGTTTGCTAAGCAGTTAGGAACCGTTATTATCATGATTG
Coelclif235  AAGATATGTATGAAAGACTTGATTTTGCTAAGCAGTTAGGACCTGTAATATTCATGATTG
C.parvula198 AAGATATGTATGAAAGAGCTGAATTTGCTAAACAACTAGGTACAGTTATTATTATGATTG
C.parvula173 AAGATATGTATGAAAGAGCTGAATTTGCTAAACAACTAGGTACAGTTATTATTATGATTG
Chacompressa AAGATATGTATGAACGAGCTGAATTTGCTAAACAACTAGGTACAGTTATTATTATGATTG
Champia214N  AAGATATGTATGAAAGAGCTGAATTTGCTAAACAGCTGGGTACAGTCATTATTATGATTG
Champia214Na AAGATATGTATGAAAGAGCTGAATTTGCTAAACAGCTGGGTACAGTCATTATTATGATTG
Cvieillar221 AAGATATGTATGAAAGAGCTGAATTTGCTAAACAACTAGGTACAGTTATTATTATGATTG
Cvieillar286 AAGATATGTATGAAAGAGCTGAATTTGCTAAACAACTAGGTACAGTTATTATTATGATTG
C.harv177    AAGATATGTATGAAAGAGCTGAATTCGCTAAGCAATTAGGAACAGTAATTATTATGATTG
Chharv160    AAGATATGTATGAAAGAGCTGAATTCGCTAAGCAATTAGGAACAGTAATTATTATGATTG
Chharv194    AAGATATGTATGAAAGAGCTGAATTCGCTAAGCAATTAGGAACAGTAATTATTATGATTG
C.sali161    AAGATATGTATGAAAGAGCTGAGTTCGCTAAGCAATTAGGAACAGTAATTATTATGATTG
chsali195    AAGATATGTATGAAAGAGCTGAGTTCGCTAAGCAATTAGGAACAGTAATTATTATGATTG
Neogastro    AAGACATGTATGAAAGAGCTGAATTTGCTAAACAATTAGGTACAGTTATTATCATGATTG
Neogastro    AAGACATGTATGAAAGAGCTGAATTTGCTAAACAATTAGGTACAGTTATTATCATGATTG
Chylocladia  AAGACATGTATGAACGAGCTGAATTTGCTAAGCAACTAGGAACTGTCATTATCATAATTG
Coelothrix   AAGACATGTATGAAAGAGCTGAATTTGCTAAGCAACTAGGAACAGTTATTATCATGATTG
Coelo215     AAGACATGTATGAAAGAGCTGAATTTGCTAAGCAATTAGGAACAGTTATTATCATGATTG
Halymenia    AAAACATGTACGAGAGGGCTGAATTTGCTAAACAACTAGGTACCGTTATTATTATGATTG
Lhako        AAGAAATGTATGAAAGAGCTGAATTTGCTAAGCAATTAGGTTCAATCATTATTATGATTG
Lhako        AAGAAATGTATGAAAGAGCTGAATTTGCTAAGCAATTAGGNNNAATCATTATTATGATTG
Ceratodicti  AAGATATGTATGAAAGGGCTGAGTTTGCTAAGCAACTAGGTACAGTTATTATCATGATTG
Cerato       AAGATATGTATGAAAGGGCTGAGTTTGCTAAGCAACTAGGTACAGTTATTATCATGATTG
Lcatenata    AANNCATGTATGAAAGAGCTGAGTTTGCTAAGCAACTAGGTACAGTTATTATTATGATTG
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Glioc        AAGAGATGTATGAAAGAGCTGAGTTTGCTAAACAACTTGGCACAGTTATTATTATGATTG
Chagardhii   AACAGATGTTCAAAAAAGTTAATTTTCCTAAGCAGTTAGGAACTGTTATTATTATGGTCG
Chprocumbens AAAACATGTACGAAAGAGCTGAGTTTGCTAANCAGCTGGGAACCGTTATTATCATGATTG
Centero143   AAAATATGTATGAGAGAGCTGAATTTGCTAAACAGCTTGGAACTGTAATCATCATGATTG
Centero201   AAAATATGTATGAGAGAGCTGAATTTGCTAAACAGCTTGGAACTGTAATCATCATGATTG
Botry        AAAATATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACCATAATTATCATGATTG
B.caraibica  AAAATATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACCATAATTATCATGATTG
Bocci172     AAAATATGTATGAAAGAGCTGAATTTGCTAAGCAGCTAGGAACTGTAATCGACATGATTG
B.occid2     AAAATATGTATGAAAGAGCTGAATTTGCTAAGCAGCTAGGAACTGTAATCGTCATGATTG
B.pyriformis AAAATATGTATGAAAGAGCTGAATTTGCTAAGCAGCTAGGTACTGTAATCATCATGATTG
B.ebriosa    AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTATCATGATTG
Bspin        AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTATCATGATTG
Bcana        AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTATCATGATTG
Bskott       AAAANATGTATGAAAGAGCTGAATTTGCTAAGCAGNNAGNNACNNTAATNNTNATGATTG
Bpapen       AAAANATGTATGAAAGAGCTGAATTTGCTAAGCAGNNAGNNACNNTAATNNTNATGATTG
Botryocladia AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTGTTATGATTG
B.botryoides AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTGTTATGATTG
Bmada        AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATTATCATGATTG
Birri224     AAAACATGTATGAGAGAGCTGAATTTGCTAAGCAGCTAGGAACTATAATTATCATGATTG
B.shanskii   AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGCTAGGAACTGTAATCATCATGATTG
B.monoica    AAGACATGTATGAGAGAGCTGAATTTGCTAAGCAGTTAGGAACTGTAATCATCATGATTG
B.uvarioides AAGACATGTATGAAAGGGCTGAATTTGCTAAGCAGCTAGGAACTGTAATCATTATGATTG
Rhodymenia   AAAACATGTATGAGAGAGCTGAGTTTGCTAAGCAGCTTGGAACTGTCATCATCATGATTG
Rhodysp.     AAAACATGTATGAGAGAGCTGAGTTTGCTAAGCAGCTTGGAACTGTCATCATCATGATTG
Rpseud       AAAACATGTATGAGAGAGCTGAGTTTGCTAAGCAGCTTGGAACTGTCATCATCATGATTG
Rdiva240     AAAACATGTATGAGAGAGCTGAGTTTGCTAAGCAGCTAGGTACTGTCATTATCATGATTG
E.capensis   AAGAGATTTATGAGAGAGCTGAATTTGCCAAGCAACTGGGTACAGTTATTGTCATGATTG
Epymenia     AAGAGATTTATGAGAGAGCTGAATTTGCCAAGCAACTGGGTACAGTTATTGTCATGATTG
E.wilsonis   AAGAGATTTATGAGAGAGCTGAATTTGCCAAGCAACTGGGTACAGTTATTGTCATGATTG
Rskott       AAGAAATGTATGAAAGAGCTGAGTTTGCTAAACAGCTAGGTACTGTCATTATCATGATTG
R.corallina  AAGAGATGTATGAGAGAGCTGAGTTTGCTAAGCAGTTAGGAAGTGTCATTATTATGATTG
Cwright      AAAACATGTATGAAAGAGCTGAGTTTGCTAAACAATTAGGAACTGTAATCGTTATGATTG
Ch.wrightii  AAAACATGTATGAAAGAGCTGAGTTTGCTAAACAATTAGGAACTGTAATCGTTATGATTG
Irvinea      AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGGGAAGTACTGTAATCATTATGATTG
Iboer        AAAACATGTATGAAAGAGCTGAATTTGCTAAGCAGGGAAGTACTGTAATCATTATGATTG
Maripelta    AAGACATGTATGAAAGAGCTGAGTTTGCTAAGCAGCTAGGAACTGTTATCATAATGATTG
Cordyle      AAAACATGTATGAGAGAGTTGAATTCGCTAAACAGCTAGGTCCTGTCATTATCATGATTG
Halichrysis  AAGATATGTACGAAAGACCTGAATTTGCTAAGCAATTAGGAACTGTAATAATCATGATCG
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Chamaebot232 ACTTGGTAGTTGGTTATACGGCTATACAAACTATGGGCATTTGGGCGCGCAAAAATGATA
Chamaebot231 ACTTGGTAGTTGGTTATACGGCTATACAAACTATGGGCATTTGGGCGCGCAGAAATGATA
Coelclif235  ACTTGGTAATAGGTTACACAGCTATACAAACTATGGGTATCTGGGCACGAAGAAATGATA
C.parvula198 ACTTAGTTATTGGTTATACAGCTATTCAGAGTATGGGTATTTGGGCTCGCAAAAATGATA
C.parvula173 ACTTAGTTATTGGTTATACAGCTATTCAGAGTATGGGTATTTGGGCTCGCAAAAATGATA
Chacompressa ACTTAGTTATTGGTTATACAGCTATTCAGAGTATGGGTATTTGGGCTCGCAAAAATGATA
Champia214N  ACTTAGTTATTGGTTATACAGCTATTCAGAGTATGGGTATTTGGGCTCGCAAAAATGATA
Champia214Na ACTTAGTTATTGGTTATACAGCTATTCAGAGTATGGGTATTTGGGCTCGCAAAAATGATA
Cvieillar221 ACTTAGTTATTGGTTATACAGCTATTCAGACTATGGGTATTTGGGCTCGTAAAAATGATA
Cvieillar286 ACTTAGTTATTGGTTATACAGCTATTCAGACTATGGGTATTTGGGCTCGTAAAAATGATA
C.harv177    ACTTAGTTATAGGTTATACAGCTATCCAAACTATGGCTATTTGGGCTCGTAAAAATGATA
Chharv160    ACTTAGTTATAGGTTATACAGCTATCCAAACTATGGCTATTTGGGCTCGTAAAAATGATA
Chharv194    ACTTAGTTATAGGTTATACAGCTATCCAAACTATGGCTATTTGGGCTCGTAAAAATGATA
C.sali161    ACTTAGTTATAGGTTATACAGCTATCCAAACTATGGCTATTTGGTCTCGTAAAAATGATA
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chsali195    ACTTAGTTATAGGTTATACAGCTATCCAAACTATGGCTATTTGGTCTCGTAAAAATGATA
Neogastro    ACTTAGTAATTGGATATACAGCTATTCAAACTATGGCTATCTGGTCACGTAAAAATGATA
Neogastro    ACTTAGTAATTGGATATACAGCTATTCAAACTATGGCTATCTGGTCACGTAAAAATGATA
Chylocladia  ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGCTATTTGGCCACGTAAAAATGATA
Coelothrix   ACTTAGTAATTGGTTATACAGCAATTCAAACTATGGCTATTTGGGCACGTAAAAATGATA
Coelo215     ACTTAGTAATTGGTTATACAGCAATTCAAACTATGGCTATTTGGGCACGTAAAAATGATA
Halymenia    ACCTTGTAGTTGGCTATACAGCAATCCAAACTATGGGTATTTGGGCTCGTAAAAATGATA
Lhako        ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGCTATCTGGGCACGTAAAAATGATA
Lhako        ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGCTATCTGGGCACGTAAAAATGATA
Ceratodicti  ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGGTATTTGGGCTCGCAAAAATGATA
Cerato       ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGGTATTTGGGCTCGCAAAAATGATA
Lcatenata    ACTTAGTAATTGGTTATACAGCTATTCAAACTATGGGTATCTGGGCTCGTAAGAACGATA
Glioc        ACCTTGTAATTGGATATACAGCTATTCAAACTATGGGTATCTGGGCACGTCGTAATGACC
Chagardhii   ATCTTGTAATCGGTTATACAGCTATACAAACTATGGGTATCTGGGCACGTAAAAATGATA
Chprocumbens ATCTTGTAGTTGGCTATACAGCTATACAAACTATGGGCATTTGGGCACGTAGAAATGATA
Centero143   ACCTTGTAATAGGCTATACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGATA
Centero201   ACCTTGTAATAGGCTATACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGATA
Botry        ACCTTGTAGTAGGCTACACAGCTATACAAACTATGGGTATTTGGGCACGTAAAAACGATA
B.caraibica  ACCTTGTAGTAGGCTACACAGCTATACAAACTATGGGTATTTGGGCACGTAAAAACGATA
Bocci172     ACCTGGTAGTAGGCTACACAGGTATAAAAACTATGGGCATTTGGGCACGTAACCGAGGTA
B.occid2     ACCTTGTAGTAGGCTACACAGCTATACAAACTATGGGTATTTGGGCACGTAAAAATGATA
B.pyriformis ACCTTGTAGTAGGCTACACGGCTATACAAACTATGGGTATTTGGGCACGTAAGAATGATA
B.ebriosa    ACCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGACA
Bspin        ACCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGACA
Bcana        ACCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGACA
Bskott       ANCTTGTANTAGGNTACACAGCTATACAAACTATGGGTATTAGGCGGCGTAAGAATGACA
Bpapen       ANCTTGTANTAGGNTACACAGCTATACAAACTATGGGTATTAGGCGGCGTAAGAATGACA
Botryocladia ATCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGACA
B.botryoides ATCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGACA
Bmada        ACCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAGAATGATA
Birri224     ACCTTGTAATAGGTTACACAGCTATACAAACTATGGGTATTTGGGCGCGTAAAAATGATA
B.shanskii   ACCTTGTAATAGGTTACACAGCTATACAAACTATGGGCATTTGGGCACGTAAGAACGATA
B.monoica    ACCTTGTAATAGGCTACACAGCTATACAAACTATGGGTATTTGGGCACGTAAGAACGATA
B.uvarioides ACCTTGTAATAGGTTACACAGCTATACAAACTATGGGTATTTGGGCACGTAAGAACGATA
Rhodymenia   ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGAATTTGGGCACGCAAAAATGATA
Rhodysp.     ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGAATTTGGGCACGCAAAAATGATA
Rpseud       ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGAATTTGGGCACGCAAAAATGATA
Rdiva240     ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGCATCTGGGCGCGTAAGAATGACA
E.capensis   ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGTATTTGGGCACGTAAGAATGATA
Epymenia     ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGTATTTGGGCACGTAAGAATGATA
E.wilsonis   ACCTTGTAATAGGTTATACAGCTATACAAACTATGGGTATTTGGGCACGTAAGAATGATA
Rskott       ATCTTGTAATAGGCTATACGGCTATACAAACTATGGGTATCTGGGCGCGTAAGAATGACA
R.corallina  ACCTTGTTATAGGCTATACAGCTATACAAACTATGGGTATTTGGGCACGTAAAAATGACA
Cwright      ACCTTGTAGTAGGTTACACAGCTATACAAACCATGGGTATTTGGGCGCGTAAAAACGATA
Ch.wrightii  ACCTTGTAGTAGGTTACACAGCTATACAAACCATGGGTATTTGGGCGCGTAAAAACGATA
Irvinea      ANCTTGTAGTAGGTTACACAGCTATACAAACTATGGGAATCTGGGCACGTAAAAATGATA
Iboer        ANCTTGTAGTTGGTTACACAGCTATACAAACTATGGGAATCTGGGCACGTAATAATGATA
Maripelta    ACCTTGTAATTGGCTATACAGCTATTCAAACTATGGGTATCTGGTCACGTAAAAACGATA
Cordyle      ACCTTGTAGTAGGTTACACAGCTATACAAACTATGGGTATCTGGGCACGTAAGAATGATA
Halichrysis  ACCTTGTAATTGGATATACNNCTATTCAAACTATGGGTATCTGGGCACGTAAAAATGACA
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Chamaebot232 TGATTTTACATTTACACCGTGCAGGTAACTCAACTTATTCTCGCCAAAAAAGTCATGGAA
Chamaebot231 TGATTTTACATTTACACCGTGCAGGTAACTCAACTTATTCTCGCCAAAAAAGTCATGGAA
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Coelclif235  TGATTTTACATTTACACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAAAGTCATGGAA
C.parvula198 TGATTTTACATTTACACCGTGCCGGTAATTCAACATACTCACGTCAAAAAAATCATGGTA
C.parvula173 TGATTTTACATTTACACCGTGCCGGTAATTCAACATACTCACGTCAAAAAAATCATGGTA
Chacompressa TGATTTTACATTTACATCGTGCCGGTAATTCAACATACTCACGTCAAAAAAATCATGGTA
Champia214N  TGATTTTACATTTACACCGTGCTGGTAATTCAACATATTCACGTCAAAAAAATCATGGTA
Champia214Na TGATTTTACATTTACACCGTGCTGGTAATTCAACATATTCACGTCAAAAAAATCATGGTA
Cvieillar221 TGATTTTACATTTACATCGTGCTGGTAATTCAACATATTCACGCCAAAAAAATCATGGTA
Cvieillar286 TGATTTTACATTTACATCGTGCTGGTAATTCAACATATTCACGCCAAAAAAATCATGGTA
C.harv177    TGATTTTACATCTGCATCGTGCAGGTAATTCAACTTATTCACGCCAAAAAAGCCATGGTA
Chharv160    TGATTTTACATCTGCATCGTGCAGGTAATTCAACTTATTCACGCCAAAAAAGCCATGGTA
Chharv194    TGATTTTACATCTGCATCGTGCAGGTAATTCAACTTATTCACGCCAAAAAAGCCATGGTA
C.sali161    TGATTTTACATCTGCATCGTGCAGGTAATTCAACTTATTCACGCCAAAAAAGCCATGGTA
chsali195    TGATTTTACATCTGCATCGTGCAGGTAATTCAACTTATTCACGCCAAAAAAGCCATGGTA
Neogastro    TGATTTTACATTTACATCGTGCAGGTAATTCAACTTACTCACGTCAAAAAAGCCATGGTA
Neogastro    TGATTTTACATTTACATCGTGCAGGTAATTCAACTTACTCACGTCAAAAAAGCCATGGTA
Chylocladia  TGATTTTACATTTGCATCGTGCAGGTAACTCAACCTACTCTCGTCAAAAAAGACATGGTA
Coelothrix   TGATCTTACATTTACATCGTGCAGGTAATTCAACGTATTCACGTCAAAAAAGCCATGGCA
Coelo215     TGATCTTACATTTACATCGTGCAGGTAATTCAACATATTCACGTCAAAAAAGACATGGTA
Halymenia    TGATTCTACACTTACATCGCGCGGGTAACTCAACTTATTCTCGTCAAAAGAGCCATGGCA
Lhako        TGATTCTGCATTTACATCGTGCAGGTAATTCAACTTATTCTCGTCAAAAAAGTCATGGTA
Lhako        TGATTCTGCATTTACATCGTGCAGGTAATTCAACTTATTCTCGTCAAAAAAGTCATGGTA
Ceratodicti  TGATATTACACTTGCACCGTGCAGGTAACTCAACTTATTCTCGCCAAAAAAGTCATGGTA
Cerato       TGATATTACACTTGCACCGTGCAGGTAACTCAACTTATTCTCGCCAAAAAAGTCATGGTA
Lcatenata    TGATCTTACACTTACACCGTGCAGGTAACTCAACTTATTCTCGCCAGAAAAGTCATGGTA
Gloioc       TGATTTTACATTTACATCGCGCAGGTAACTCAACTTACTCTCGTCAAAAAAGTCATGGTA
Chagardhii   TGATTTTACATTTGCACCGCGCAGGTAATTCAACTTACTCTCGCCAAAAGAGCCATGGTA
Chprocumbens TGATTTTACATTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGCA
Centero143   TGATTTTACACTTACATCGCGCAGGTAACTCAACTTATTCTCGTCAAAAGAGTCATGGCA
Centero201   TGATTTTACACTTACATCGCGCAGGTAACTCAACTTATTCTCGTCAAAAGAGTCATGGCA
Botry        TGATTTTACACTTACACCGCGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGTA
B.caraibica  TGATTTTACACTTACACCGCGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGTA
Bocci172     TGATTTTACATTTACACAGCGCAGGTAACTCAACTTATTCTCGTCAAAAGAGTCATGGTA
B.occid2     TGATTTTACATTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAGAGTCATGGTA
B.pyriformis TGATTCTACACTTGCACCGCGCAGGTAACTCAACGTATTCTCGTCAAAAGAGTCATGGTA
B.ebriosa    TGATTCTGCATTTGCACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGTA
Bspin        TGATTCTGCATTTGCACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGTA
Bcana        TGATTCTGCATTTGCACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGTA
Bskott       TGATTCTGCATTTGCTCCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGTA
Bpapen       TGATTCTGCATTTGCTCCGTGCAGGTAANTCCACTTATTCTCGCCAAAAGAGTCATGGTA
Botryocladia TGATTCTGCATTTACACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGCA
B.botryoides TGATTCTGCATTTACACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGCA
Bmada        TGATTCTGCATTTGCACCGTGCAGGTAATTCAACTTATTCTCGCCAAAAGAGTCATGGCA
Birri224     TGATTCTGCATTTACACCGTGCAGGTAACTCAACTTATTCTCGCCAAAAGAGTCATGGTA
B.shanskii   TGATTCTACACTTGCACCGCGCAGGTAACTCAACTTATTCTCGCCAAAAGAGCCATGGTA
B.monoica    TGATTCTACACTTACACCGTGCAGGTAACTCAACTTACTCTCGTCAAAAGAGCCATGGTA
B.uvarioides TGATTCTACACTTACACCGCGCAGGTAACTCAACTTATTCTCGTCAAAAGAGTCACGGTA
Rhodymenia   TGATCTTGCATTTACACCGTGCAGGTAATTCAACTTATTCTCGTCAAAAGAATCATGGTA
Rhodysp.     TGATCTTGCATTTACACCGTGCAGGTAATTCAACTTATTCTCGTCAAAAGAATCATGGTA
Rpseud       TGATCTTGCATTTACACCGTGCAGGTAATTCAACTTATTCTCGTCAAAAGAATCATGGTA
Rdiva240     TGATTTTACATTTACACCGTGCAGGTAATTCAACTTACTCTCGTCAAAAAAATCATGGCA
E.capensis   TGATCTTACATTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGAA
Epymenia     TGATCTTACACTTACATCGCGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGAA
E.wilsonis   TGATCTTACATTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAAAGTCATGGAA
Rskott       TGATTTTACATTTACATCGCGCAGGTAACTCAACTTATTCTCGCCAAAAGAGTCATGGAA
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R.corallina  TGATTTTACATTTGCATCGCGCAGGTAACTCAACTTACTCTCGTCAAAAAAGTCACGGAA
Cwright      TGATTTTACACTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAAAATCACGGTA
Ch.wrightii  TGATTTTACACTTACATCGTGCAGGTAACTCAACTTATTCTCGTCAAAAAAATCACGGTA
Irvinea      TGATTTTACACTTACATCGCGCAGGTAACTCAACTTATTCTCGTCAAAAGAGCCATGGTA
Iboer        TGATTGTGCACTTACATCGCGCAGGTAACTCAACTTATTNTCGTCAAAAGAGCCATGGTA
Maripelta    TGATTTTACATTTACATCGCGCAGGTAATTCAACTTATTCTCGTCAAAAGAGTCATGGCA
Cordyle      TGATCTTACATTTGCATCGTGCAGGTAACTCAACTTATTCTCGTCAGAAGAGTCACGGTA
Halichrysis  TGATTTTACACTTACATCGTGCGGGTAATTCGACTTATTCTCGTCAAAAAAGTCACGGCA
             ****  * **  * *   * ** ***** ** ** ** *  ** ** ** *  ** ** *

Chamaebot232 TGAACTTCCGCGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATTCATGCTG
Chamaebot231 TGAACTTCCGCGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATTCATGCTG
Coelclif235  TGAATTTCCGGGTAATTTGTAAATGGATGCGTATGGCGGGGGTAGACCATATACATGCTG
C.parvula198 TGAATTTCCGTGTAATTTGTAAGTGGATGCGTATGGCAGGTGTTGATCATATTCATGCTG
C.parvula173 TGAATTTCCGTGTAATTTGTAAGTGGATGCGTATGGCAGGTGTTGATCATATTCATGCTG
Chacompressa TGAATTTCCGTGTAATTTGTAAGTGGATGCGTATGGCAGGTGTTGACCATATTCATGCTG
Champia214N  TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCAGGTGTTGATCATATTCATGCTG
Champia214Na TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCAGGTGTTGATCATATTCATGCTG
Cvieillar221 TGAATTTCCGTGTAATTTGTAAGTGGATGCGTATGGCTGGTGTTGACCATATTCATGCTG
Cvieillar286 TGAATTTCCGTGTAATTTGTAAGTGGATGCGTATGGCTGGTGTTGACCATATTCATGCTG
C.harv177    TGAATTTCCGAGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATCCATGCTG
Chharv160    TGAATTTCCGCGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATCCATGCTG
Chharv194    TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATCCATGCTG
C.sali161    TGAATTTCCGAGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATCCATGCTG
chsali195    TGAATTTCCGAGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATCCATGCTG
Neogastro    TGAATTTTCGTGTAATTTGTAAGTGGATGCGTATGGCTGGTGTAGATCATATTCATGCTG
Neogastro    TGAATTTTCGTGTAATTTGTAAGTGGATGCGTATGGCTGGTGTAGATCATATTCATGCTG
Chylocladia  TGAATTTTCGTGTAATTTGTAAGTGGATGCGTAAGGCAGGTGTAGATCATATACATGCTG
Coelothrix   TGAACTTTCGTGTGATTTGCAAGTGGATGCGTATGGCAGGTGTAGATCATATTCATGCGG
Coelo215     TGAACTTTCGTGTAATTTGTAAATGGATGCGTATGGCAGGTGTAGATCATATTCATGCGG
Halymenia    TGAACTTCCGTGTAATATGTAAATGGATGCGTATGGCAGGTGTGGACCATATTCATGCAG
Lhako        TGAATTTCAGAGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCATATTCATGCTG
Lhako        TGAATTTCAGAGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCATATTCATGCTG
Ceratodicti  TGAACTTTAGAGTAATCTGTAAATGGATGCGTATGGCTGGTGTAGACCATATCCACGCAG
Cerato       TGAACTTTAGAGTAATCTGTAAATGGATGCGTATGGCTGGTGTAGACCATATCCACGCAG
Lcatenata    TGAACTTTAGAGTAATCTGTAAGTGGATGCGTATGGCCGGTGTAGACCATATTCACGCAG
Gloioc       TGAATTTTCGCGTAATCTGTAAGTGGATGCGTATGGCTGGTGTAGATCATATTCATGCTG
Chagardhii   TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGTGTAGATCATATACATGCTG
Chprocumbens TGAATTTTCGAGTGATTTGTAAGTGGATGCGTATGGCTGGGGTAGATCATATACATGCTG
Centero143   TGAATTTCCGTGTAATCTGCAAATGGATGCGCATGGCTGGTGTAGACCACATACATGCTG
Centero201   TGAATTTCCGTGTAATCTGCAAATGGATGCGCATGGCTGGTGTAGACCACATACATGCTG
Botry        TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
B.caraibica  TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
Bocci172     TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGGGTAGATCATATACATGCTG
B.occid2     TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
B.pyriformis TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGAGTAGATCATATACATGCTG
B.ebriosa    TGAACTTTCGTGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCACATACATGCTG
Bspin        TGAACTTTCGTGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCACATACATGCTG
Bcana        TGAACTTTCGTGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCACATACATGCTG
Bskott       TGAACTTGCGTGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGATCACATACATGCTG
Bpapen       TGAACTTTCGTGTAATCTGTAAATGGATGCGTATGGCTGGGGTAGATCACATACATGCTG
Botryocladia TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGTGTAGATCACATACATGCTG
B.botryoides TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGTGTAGATCACATACATGCTG
Bmada        TGAACTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGTGTAGACCACATACATGCTG
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Birri224     TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCACATACATGCTG
B.shanskii   TGAATTTTCGTGTAATTTGTAAGTGGATGCGTATGGCTGGTGTGGACCATATACATGCTG
B.monoica    TGAATTTCCGTGTAATCTGTAAATGGATGCGTATGGCTGGCGTAGACCATATACATGCTG
B.uvarioides TGAATTTCCGCGTAATTTGTAAATGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
Rhodymenia   TGAATTTCCGTGTAATTTGTAAATGGATGCGCATGGCTGGTGTAGACCATATACATGCCG
Rhodysp.     TGAATTTCCGTGTAATTTGTAAATGGATGCGCATGGCTGGTGTAGACCATATACATGCCG
Rpseud       TGAATTTCCGTGTAATTTGTAAATGGATGCGCATGGCTGGTGTAGACCATATACATGCCG
Rdiva240     TGAATTTCCGTGTAATTTGCAAATGGATGCGTATGGCTGGTGTAGACCATATACATGCTG
E.capensis   TGAACTTCCGTGTAATTTGTAAATGGATGCGCATGGCTGGTGTAGACCATATACATGCTG
Epymenia     TGAACTTCCGTGTGATTTGTAAATGGATGCGTATGGCTGGTGTAGACCATATACATGCTG
E.wilsonis   TGAACTTCCGTGT-ATTTGTAAATGGATGCG-ATGGCTGGTGTAGACCATATACATGCTG
Rskott       TGAATTTTCGTGTGATTTGTAAATGGATGCGCATGGCTGGCGTAGACCATATACATGCTG
R.corallina  TGAACTTCCGTGTAATTTGCAAATGGATGCGTATGGCTGGCGTAGACCATATACATGCTG
Cwright      TGAATTTCCGTGTAATTTGCAAGTGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
Ch.wrightii  TGAATTTCCGTGTAATTTGCAAGTGGATGCGTATGGCTGGCGTAGATCATATACATGCTG
Irvinea      TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCGGGTGTAGATCATATACATGCTG
Iboer        TGAATTTCCGTGTAATTTGTAAATGGATGCGTATGGCGGGTGTAGATCATATACATGCTG
Maripelta    TGAATTTCCGCGTAATCTGTAAATGGATGCGTATGGCGGGTGTAGACCATATTCATGCTG
Cordyle      TGAACTTCCGTGTAATCTGTAAGTGGATGCGTATGGCTGGCGTAGACCATATACACGCTG
Halichrysis  TGAATTTCCGTGTAATATGTAAATGGATGCGTATGGCTGGAGTAGATCATATACATGCTG
             **** **  * ** ** ** ** ******** * *** ** ** ** ** ** ** ** *

Chamaebot232 GTACAGTAGTTGGTAAACTAGAAGGCGACCCTCTAATGATTAGAGGTTTCTATAATACCT
Chamaebot231 GTACAGTAGTTGGTAAACTAGAAGGCGACCCTCTAATGATTAGAGGTTTCTATAATACCT
Coelclif235  GTACAGTAGTTGGTAAATTAGAGGGTGACCCTTTAATGATTAGAGGTTTCTATAATACTT
C.parvula198 GTACAGTTGTAGGTAAGTTGGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAACACTT
C.parvula173 GTACAGTTGTAGGTAAGTTGGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAACACTT
Chacompressa GTACAGTTGTAGGTAAGTTAGAAGGTGATCCTCTAATGATTAAAGGTTTCTATAACACTT
Champia214N  GTACAGTTGTAGGTAAGTTAGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAACACTT
Champia214Na GTACAGTTGTAGGTAAGTTAGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAACACTT
Cvieillar221 GTACAGTTGTAGGTAAGCTAGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAATACTT
Cvieillar286 GTACAGTTGTAGGTAAGCTAGAAGGTGATCCTTTAATGATTAAAGGTTTTTATAATACTT
C.harv177    GTACAGTTGTAGGTAAATTAGAGGGTGATCCTTTAATGATTAAAGGTTTTTATGATACTT
Chharv160    GTACAGTTGTAGGTAAATTAGAGGGTGATCCTTTAATGATTAAAGGTTTTTATGATACTT
Chharv194    GTACAGTTGTAGGTAAATTAGAGGGTGATCCTTTAATGATTAAAGGTTTTTATGATACTT
C.sali161    GTACAGTTGTAGGTAAATTAGAGGGTGATCCTTTAATGATTAAAGGTTTTTATGATACTT
chsali195    GTACAGTTGTAGGTAAATTAGAGGGTGATCCTTTAATGATTAAAGGTTTTTATGATACTT
Neogastro    GAACAGTTGTAGGTAAACTAGAAGGTGACCCATTAATGATTAAAGGTTTTTATGATACTT
Neogastro    GAACAGTTGTAGGTAAACTAGAAGGTGACCCATTAATGATTAAAGGTTTTTATGATACTT
Chylocladia  GAACAGTTGTAGGTAAACTAGAAGGTGACCCATTAATGATTAAAGGTTTTTATGATACTT
Coelothrix   GTACTGTTGTAGGTAAGCTAGAAGGCGATCCTCTAATGATTAGAGGTTTTTATAATACTT
Coelo215     GTACTGTTGTAGGTAAACTAGAAGGCGATCCTCTAATGATTAGAGGTTTTTATAATACTT
Halymenia    GTACTGTTGTTGGTAAGCTAGAAGGTGATCCTTTAATGATCAGAGGTTTTTATAATACTC
Lhako        GTACAGTTGTTGGTAAGTTAGAAGGTGATCCTTTAATGATTAGAGGTTTTTACAATACTT
Lhako        GTACAGTTGTTGGTAAGTTAGAAGGTGATCCTTTAATGATTAGAGGTTTTTACAATACTT
Ceratodicti  GTACTGTTGTAGGTAAACTAGAAGGTGATCCTTTAATGATTAGAGGCTTTTACAATACTC
Cerato       GTACTGTTGTAGGTAAACTAGAAGGTGATCCTTTAATGATTAGAGGCTTTTACAATACTC
Lcatenata    GTACTGTTGTAGGTAAACTAGAGGGAGATCCTTTAATGATTAGAGGTTTTTATAATACTC
Glojoc       GTACAGTAGTTGGTAAATTAGAAGGTGATCCTTTAATGATTAGAGGATTTTATGATACTT
Chagardhii   GTACAGTAGTAGGTAAACTGGAAGGTGATCCTTTAATGATCAGAGGTTTTTACAATACTT
Chprocumbens GTACAGTAGTTGGTAAATTAGAAGGTGATCCTTTAATGATTAGAGGCTTCTATAATACTT
Centero143   GTACAGTAGTTGGTAAACTAGAAGGTGATCCTCTAATGATTAGAGGATTCTATAATACTT
Centero201   GTACAGTAGTTGGTAAACTAGAAGGTGATCCTCTAATGATTAGAGGATTCTATAATACTT
Botry        GTACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATTAGAGGATTTTATAATACTT
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B.caraibica  GTACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATTAGAGGATTTTATAATACTT
Bocci172     GTACAGTAGTTGGTAAACTAGAAGGCGTTCCTTTAATGATCAGAGGATTCTATAATACTT
B.occid2     GTACAGTAGTTGGTAAACTAGAAGGCGATCCTTTAATGATCAGAGGATTCTATAATACTT
B.pyriformis GTACAGTAGTTGGTAAACTAGAAGGCGATCCTTTAATGATCAGAGGATTCTATAATACTT
B.ebriosa    GGACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
Bspin        GGACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
Bcana        GGACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
Bskott       GGACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
Bpapen       GGACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
Botryocladia GTACAGTAGTTGGTAAACTAGAAGGTGATCCTGTAATGATCAGAGGATTCTATAACACTT
B.botryoides GTACAGTAGTTGGTAAACTAGAAGGTGATCCTGTAATGATCAGAGGATTCTATAACACTT
Bmada        GTACAGTAGTTGGTAAACTAGAAGGCGATCCTGTGATGATTAGAGGATTCTATAACACTT
Birri224     GTACAGTAGTTGGTAAACTAGAAGGTGATCCTTTAATGATCAGAGGATTCTATAACACTT
B.shanskii   GTACAGTAGTTGGCAAATTAGAGGGTGACCCTCTAATGATCAGAGGATTCTATAATACTT
B.monoica    GTACAGTAGTTGGTAAACTAGAAGGCGACCCTCTAATGATCAGAGGATTCTATAATACTT
B.uvarioides GTACGGTAGTTGGTAAACTAGAAGGCGACCCTTTAATGATTAAAGGATTCTATAACACTC
Rhodymenia   GTACAGTAGTTGGTAAATTAGAAGGCGATCCTTTAATGATCAGAGGCTTCTACAATACTT
Rhodysp.     GTACAGTAGTTGGTAAATTAGAAGGCGATCCTTTAATGATCAGAGGCTTCTACAATACTT
Rpseud       GTACAGTAGTTGGTAAATTAGAAGGCGATCCTTTAATGATCAGAGGCTTCTACAATACTT
Rdiva240     GTACAGTAGTTGGTAAATTAGAAGGCGATCCTCTAATGATCAGAGGTTTCTACAATACTC
E.capensis   GTACAGTAGTTGGTAAGCTAGAAGGTGATCCTCTAATGATCAGAGGCTTCTATAACACTT
Epymenia     GTACAGTAGTTGGTAAGCTAGAAGGTGATCCTCTAATGATCAGAGGCTTCTATAATACTT
E.wilsonis   GTACAGTAGTTGGTAAGCTAGAAGGTGATCCTCTAATGATCAGAGGCTTCTATAATACTT
Rskott       GTACAGTAGTTGGTAAGCTAGAAGGTGATCCACTAATGATCAGAGGCTTCTACAATACCC
R.corallina  GTACAGTAGTTGGTAAGCTGGAAGGCGATCCTTTAATGATCAAAGGATTCTATGACACTT
Cwright      GTACAGTGGTTGGTAAACTAGAAGGCGATCCTTTAATGATCAGAGGATTCTATAATACTT
Ch.wrightii  GTACAGTGGTTGGTAAACTAGAAGGCGATCCTTTAATGATCAGAGGATTCTATAATACTT
Irvinea      GTACTGTAGTTGGTAAACTAGAGGGAGATCCTCTAATGATCAGAGGCTTCTACAATACTT
Iboer        GTACTGTAGTTGGTAAACTAGAGGGAGATCCTCTAATGATCAGAGGCTTCTACAATACTT
Maripelta    GTACAGTAGTAGGTAAGTTAGAAGGAGATCCTTTGATGATTAAAGGCTTCTACAATACTT
Cordyle      GTACAGTAGTTGGTAAGCTAGAGGGCGATCCTCTAATGATTAGAGGCTTCTACAATACTT
Halichrysis  GTACAGTAGTTGGTAAATTAGAAGGTGATCCATTAATGATTAGAGGATTCTATAATACTT
             * ** ** ** ** **  * ** ** *  **  * ***** * *** ** **  * **

Chamaebot232 TACTATTCACCCATCTAGATGTAAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Chamaebot231 TACTATTCACCCATCTAGATGTAAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Coelclif235  TATTATTAACTCATCTAGATGTAAATCTACCTCAAGGATTATTCTTTGAGCAAGATTGGG
C.parvula198 TATTATTAACTCATTTAAACGTTAATTTACCTCAAGGAATTTTCTTTGAACAAGATTGGG
C.parvula173 TATTATTAACTCATTTAAACGTTAATTTACCTCAAGGAATTTTCTTTGAACAAGATTGGG
Chacompressa TATTATTAACTCATTTAAGCGTTAATTTACCTCAAGGAATTTTCTTTGAACAAGATTGGG
Champia214N  TATTATTAACTCATTTAGAAGTAAATTTACCTCAAGGAATTTTCTTCGAACAAGATTGGG
Champia214Na TATTATTAACTCATTTAGAAGTAAATTTACCTCAAGGAATTTTCTTCGAACAAGATTGGG
Cvieillar221 TATTATTAACTCATTTAGATGTAAATTTACCTCAAGGTATTTTCTTCGAACAAGATTGGG
Cvieillar286 TATTATTAACTCATTTAGATGTAAATTTACCTCAAGGTATTTTCTTCGAACAAGATTGGG
C.harv177    TATTATTAACTCATTTAAGGGTTAATTTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Chharv160    TATTATTAACTCATTTAAGGGTTAATTTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Chharv194    TATTATTAACTCATTTAAGGGTTAATTTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
C.sali161    TATTATTAACTCATTTAAGTGTTAATCTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
chsali195    TATTATTAACTCATTTAAGTGTTAATCTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Neogastro    TATTATTAACTAATTTAGATGTTAATCTTCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Neogastro    TATTATTAACTAATTTAGATGTTAATCTTCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Chylocladia  TATTATTAACTCATTTAGATGTGAATTTGCCTCAAGGTATTTTCTTTGAACAAGATTGGG
Coelothrix   TATTATTGACTTATTTAGATGTGAATTTACCTCAAGGTATTTTCTTTGAACAAGATTGGG
Coelo215     TATTATTGACTCATTTAGAAGTAAATTTACCTCAAGGTATTTTCTTTGAACAAGATTGGG
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Halymenia    TACTACTAACACATCTAGATGTTAACTTACCACAAGGTATTTTCTTCGAGCAAGATTGGG
Lhako        TACTTCTAACTCACTTATCAGTAAATTTACCTCAAGGTATATTTTTTGAGCAAGATTGGG
Lhako        TACTTCTAACTCACTTATCAGTAAATTTACCTCAAGGTATATTTTTTGAGCAAGATTGGG
Ceratodicti  TTTTACTTACTCATTTATCAGTAAACTTACCTCAAGGTATATTTTTTGAACAAGATTGGG
Cerato       TTTTACTTACTCATTTATCAGTAAACTTACCTCAAGGTATATTTTTTGAACAAGATTGGG
Lcatenata    TTTTACTTACTCACTTAGCAGTAAACCTACCTCAAGGTATATTTTTTGAACAAGATTGGG
Glioc        TACTAGTGACTCATTTAAAAGTTGATCTTCCCAAAGGGATTTTCTTCGAACAAGATTGGG
Chagardhii   TACTGTTTACTCATCTAGATGTAAACCTGCCTCAAGGTATATTCTTTGAGCAAGATTGGG
Chprocumbens TACTATTTACTCATTTAGATGTAAATTTACCTCAGGGAATTTTCTTTGAACAAGACTGGG
Centero143   TATTATTTACTCACCTAGATGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Centero201   TATTATTTACTCACCTAGATGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Botry        TACTTTTCACTCATTTAGATGTTAATCTTCCTCAAGGTATCTTCTTTGAACAAGACTGGG
B.caraibica  TACTTTTCACTCATTTAGATGTTAATCTTCCTCAAGGTATCTTCTTTGAACAAGACTGGG
Bocci172     TACTGTTCACTCATTTGGATGTGAATTTGCCTCAAGGTATATTCTTTGAGCAAGATTGGG
B.occid2     TACTGTTCACTCATTTGGATGTGAATTTGCCTCAAGGTATATTCTTTGAGCAAGATTGGG
B.pyriformis TACTATTTACTCATTTGGACGTAAATCTGCCTCAAGGCATCTTCTTTGAGCAAGATTGGG
B.ebriosa    TATTGTTTACTCATTTAAGTGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Bspin        TATTGTTTACTCATTTAAGTGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Bcana        TATTGTTTACTCATTTAAGTGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Bskott       TATTGTTTACTCATTTAAGTGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Bpapen       TATTGTTTACTCATTTAAGTGTAAATCTACCTCAAGGTATCTTCTTTGAGCAAGATTGGG
Botryocladia TACTGTTTACTCATTTAGATGTAAATCTACCTCAAGGCATCTTCTTTGAGCAAGATTGGG
B.botryoides TACTGTTTACTCATTTAGATGTAAATCTACCTCAAGGCATCTTCTTTGAGCAAGATTGGG
Bmada        TATTATTTACTCATTTAGATGTAAATCTACCTCAAGGCATCTTCTTTGAGCAAGATTGGG
Birri224     TACTATTTACTCATTTAGATGTAAATCTACCTCAAGGTATTTTCTTTGAACAAGATTGGG
B.shanskii   TACTGTTAACTCATTTAGACGTAAATCTACCTCAAGGTATTTTCTTTGAACAGGATTGGG
B.monoica    TACTATTAACTCATCTAGATGTAAATCTGCCTCAAGGTATTTTCTTTGAACAGGATTGGG
B.uvarioides TACTATTAACTCATTTACCTGTGAATCTACCTCAGGGCATTTTCTTTGAACAGGATTGGG
Rhodymenia   TACTTTTCACTCATTTAGATGTGAATTTACCTCAAGGAATCTTCTTCGAACAAGATTGGG
Rhodysp.     TACTTTTCACTCATTTAGATGTGAATTTACCTCAAGGAATCTTCTTCGAACAAGATTGGG
Rpseud       TACTTTTCACTCATTTAGATGTGAATTTACCTCAAGGAATCTTCTTCGAACAAGATTGGG
Rdiva240     TACTTTTTACTCATTTAGATGTGAATTTACCTCAAGGTATTTTCTTTGAACAAGATTGGG
E.capensis   TGCTTTTTACTCATTTAGATGTGAATCTACCTCAAGGTATTTTCTTTGAACAAGACTGGG
Epymenia     TGCTTGTTACTCATTTAGATGTGAATCTACCTCAAGGTATTTTCTTTGAACAAGACTGGG
E.wilsonis   TACTTGTTACTCATTTAGATGTGAATCTACCTCAAGGTATTTTCTTTGAACAAGACTGGG
Rskott       TACTTTTAACTCATTTGGATGTGAATTTACCTCAAGGTATTTTCTTTGAGCAAGACTGGG
R.corallina  TACTTTTAACTCATTTAGATATGAATTTACCTCAAGGTATTTTCTTTGAACAAGATTGGG
Cwright      TACTCTTAACTCATTTAGATGTGAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Ch.wrightii  TACTCTTAACTCATTTAGATGTGAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Irvinea      TATTAATGACTCATTTAGATGTAAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Iboer        TATTAATGACTCATTTAGATGTAAATCTACCTCAAGGTATTTTCTTTGAGCAAGATTGGG
Maripelta    TACTTTTAACTCATTTAGATGTAAATTTACCGCAAGGTATTTTCTTTGAGCAAGATTGGG
Cordyle      TGCTATTAACTCATCTAGACGTTAATCTACCTCAAGGTATATTCTTTGAGCAAGATTGGG
Halichrysis  TATTATTAACTACTCTAGATGTGAATCTACCTCAAGGATTTTTCTTTGAGCAGGATTGGG
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Chamaebot232 CATCTTTACGTAAAGTAACTCCTGTTGCATCAGGCGGTATTCACTGTGGACAAATGCATC
Chamaebot231 CATCTTTACGTAAAGTAACTCCTGTTGCATCAGGCGGTATTCACTGTGGACAAATGCATC
Coelclif235  CATTTTTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCATTGGGGGCAAATGCATC
C.parvula198 CTGCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATTCATTGTGGTCAAATGCATC
C.parvula173 CTGCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATTCATTGTGGTCAAATGCATC
Chacompressa CGGCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATCCATTGTGGTCAAATGCATC
Champia214N  CAGCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATCCATTGTGGTCAAATGCATC
Champia214Na CAGCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATCCATTGTGGTCAAATGCATC
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Cvieillar221 CATCTTTACGTAAAGTTACTCCTGTTGCATCTGGTGGTATCCATTGTGGTCAAATGCATC
Cvieillar286 CATCTTTACGTAAAGTGACTCCTGTTGCATCTGGTGGTATCCATTGTGGTCAAATGCATC
C.harv177    CTTCTTTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
Chharv160    CTTCTTTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
Chharv194    CTTCTTTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
C.sali161    CATCTTTACGTAAAGTTACTCCTGTAGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
chsali195    CATCTTTACGTAAAGTTACTCCTGTAGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
Neogastro    CCGCTCTACGTAAAGTTACTCCTGTTGCATCAGGAGGTATTCATTGTGGTCAAATGCATC
Neogastro    CCGCTCTACGTAAAGTTACTCCTGTTGCATCAGGAGGTATTCATTGTGGTCAAATGCATC
Chylocladia  CCTGTCTACGTAAAGTTACTTCTGTTGCATCAGGTGGTATCCATTGTGGTCAAATGCATC
Coelothrix   CATCTTTACGTAAAGTTACTCCTGTTGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
Coelo215     CTTCTTTACGTAAAGTTACTCCTGTTGCATCAGGTGGTATTCACTGTGGTCAAATGCATC
Halymenia    CATCTCTGCGTAAAGTAACTCCTGTTGCTTCAGGTGGTATCCACTGTGGACAAATGCATC
Lhako        CATCATTACGTAAAGTAACACCTGTTGCTTCAGGTGGTATTCATTGTGGACAAATGCATC
Lhako        CATCATTACGTAAAGTAACACCTGTTGCTTCAGGTGGTATTCATTGTGGACAAATGCATC
Ceratodicti  CATCATTACGTAAAGTAACTCCTGTTGCTTCTGGTGGTATCCACTGTGGACAAATGCATC
Cerato       CATCATTACGTAAAGTAACNCCNGTTGCTTCNGGTGGTATNCANTGTGGACAAATGCATC
Lcatenata    CATCATTACGTAAAGTAACTCCAGTTGCTTCAGGTGGTATTCATTGTGGACAAATGCATC
Gloioc       CTTCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATCCATTGCGGACAAATGCATC
Chagardhii   CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCACTGTGGCCAGATGCATC
Chprocumbens CATCCTTACGTAAAGTAACTCCTGTTGCTTCAGGCGGTATTCATTGTGGACAAATGCATC
Centero143   CATCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCACTGTGGACAGATGCATC
Centero201   CATCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCACTGTGGACAGATGCATC
Botry        CGTCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGGCAAATGCATC
B.caraibica  CGTCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGGCAAATGCATC
Bocci172     CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
B.occid2     CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
B.pyriformis CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGCGGTATTCACTGTGGACAAATGCATC
B.ebriosa    CATCTTTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Bspin        CATCTTTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Bcana        CATCTTTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Bskott       CATCTTTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Bpapen       CATCTTTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Botryocladia CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
B.botryoides CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
Bmada        CATCTTTACGTAAAGTAACTCCTGTTGCTTCGGGTGGTATTCACTGCGGACAAATGCATC
Birri224     CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCATTGCGGACAAATGCATC
B.shanskii   CATCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCACTGCGGACAAATGCATC
B.monoica    CATCTCTACGTAAAGTAACTCCTGTTGCTTCAGGTGGTATTCACTGTGGACAAATGCATC
B.uvarioides CATCTCTACGTAAGGTAACTCCTGTTGCTTCAGGTGGTATCCATTGTGGACAAATGCATC
Rhodymenia   CATCTCTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
Rhodysp.     CATCTCTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
Rpseud       CATCTCTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
Rdiva240     CATCTCTACGTAAGGTAACTCCTGTTGCATCAGGTGGTATTCACTGTGGACAAATGCATC
E.capensis   CATCTCTACGTAAGGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
Epymenia     CATCTCTACGTAAGGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
E.wilsonis   CGTCTCTACGTAAGGTAACTCCTGTTGCATCAGGTGGTATTCACTGCGGACAAATGCATC
Rskott       CATCTCTACGTAAAGTAACCCCTGTTGCATCAGGTGGTATCCATTGCGGACAAATGCATC
R.corallina  CATCTCTGCGTAAGGTAACTCCTGTTGCATCAGGCGGTATTCATTGTGGACAAATGCATC
Cwright      CATCTTTACGTAAAGTAACCCCTGTTGCTTCGGGCGGTATCCACTGTGGACAAATGCATC
Ch.wrightii  CATCTTTACGTAAAGTAACCCCTGTTGCTTCGGGCGGTATCCACTGTGGACAAATGCATC
Irvinea      CATCTTTACGTAAAGTAACTCCTGTTGCCTCAGGTGGTATTCACTGTGGACAAATGCATC
Iboer        CATCTTTACGTAAAGTAACTCCTGTTGCCTCAGGTGGTATTCACTGTGGACAAATGCATC
Maripelta    CATCTTTACGTAAAGTAACTCCTGTTGCTTCAGGCGGTATTCACTGTGGTCAAATGCATC
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Cordyle      CATCTTTACGTAAAGTAACTCCTGTTGCATCAGGTGGTATTCATTGCGGACAAATGCACC
Halichrysis  CA------CGTAA--TAACTCCTGTTGC-------GGTATTCA--------AAATGCA-C
             *       *****  * **  * ** **       ***** **        * ***** *

Chamaebot232 AATTACTAGATTATCTTGGAAATGATGTTGTTCTTCAGTTTGGTGGAGGTACAATTGGTC
Chamaebot231 AATTACTAGATTATCTTGGAAATGATGTTGTTCTTCAGTTTGGTGGAGGTACAATTGGTC
Coelclif235  AATTTCTAGATTATCTTGGTAAAGATGTTGTTCTTCAGTTTGGTGGGAGTACAATTGGTC
C.parvula198 AATTGCTAGATTATCTTGGTAATGATGTTGTACTTCAGTTTGGTGGAGGTACAATAGGTC
C.parvula173 AATTGCTAGATTATCTTGGTAATGATGTTGTACTTCAGTTTGGTGGAGGTACAATAGGTC
Chacompressa AATTGCTAGATTATCTTGGTAATGATGTTGTCCTTCAGTTTGGTGGAGGTACAATAGGTC
Champia214N  AATTATTAGATTATCTTGGTAATGATGTTGTACTTCAGTTTGGTGGAGGTACAATAGGTC
Champia214Na AATTATTAGATTATCTTGGTAATGATGTTGTACTTCAGTTTGGTGGAGGTACAATAGGTC
Cvieillar221 AATTTTTAGATTATCTTGGTAATGATGTTGTACTTCAATTTGGTGGAGGTACTATAGGTC
Cvieillar286 AATTTTTAGATTATCTTGGTAATGATGTTGTACTTCAATTTGGTGGAGGTACTATAGGTC
C.harv177    AATTATTAGATTATCTTGGAAATGATGTTGTACTTCAATTTGGTGGAGGAACTATAGGTC
Chharv160    AATTATTAGATTATCTTGGAAATGATGTTGTACTTCAATTTGGTGGAGGAACTATAGGTC
Chharv194    AATTATTAGATTATCTTGGAAATGATGTTGTACTTCAATTTGGTGGAGGAACTATAGGTC
C.sali161    AATTATTAGATTATCTTGGAAATGATGTTGTACTTCAGTTTGGTGGAGGTACTATTGGTC
chsali195    AATTATTAGATTATCTTGGAAATGATGTTGTACTTCAGTTTGGTGGAGGTACTATTGGTC
Neogastro    AACTTTTAGATTATCTTGGTATTGATGTTGTGCTTCAGTTTGGTGGTGGTACTATTGGTC
Neogastro    AACTTTTAGATTATCTTGGTATTGATGTTGTGCTTCAGTTTGGTGGTGGTACTATTGGTC
Chylocladia  AATTGCTAGATTATCTTGGTATCGATGTAGTCCTTCAGTTTGGTGGAGGCACAATAGGTC
Coelothrix   AATTATTAGATTATCTAGGTGAAGATGTTGTACTTCAGTTTGGTGGAGGTACTATTGGTC
Coelo215     AATTATTAGATTATCTAGGTAAAGATGTTGTACTTCAGTTTGGTGGAGGAACTATTGGTC
Halymenia    AATTACTAGATTATCTTGGTGAAGATGTTGTACTACAATTTGGCGGAGGTACAATTGGTC
Lhako        AATTGCTAGATTATCTAGGAAATGATGTAGTTCTTCAGTTTGGTGGAGGTACAATTGGTC
Lhako        AATTGCTAGATTATCTAGGAATTGATGTAGTTCTTCAGTTTGGTGGAGGTACAATTGGTC
Ceratodicti  AGTTATTAGATTATCTAGGTGAAGATGTAGTACTTCAGTTTGGTGGAGGAACAATCGGTC
Cerato       ANNTNNTAGATTATNTAGGNNNNGATGTAGTACTTCANTTTGGTGGAGGNACAATNGGTC
Lcatenata    AACTATTAGATTATTTAGGTATTGATGTAGTACTTCAATTTGGTGGAGGTACAATTGGTC
Glioc        AACTATTAGATTACCTTGGTAATGATGTTGTTCTTCAATTCGGTGGTGGTACAATTGGTC
Chagardhii   AATTGCTAGACTATCTTGGAGAAGATGTTGTGCTTCAGTTTGGTGGGGGTACAATTGGTC
Chprocumbens AATTATTAGACTATCTTGGTGTGGATGTTGTGCTTCAGTTTGGTGGAGGTACAATTGGTC
Centero143   AGCTGTTAGATTATCTTGGTAATGATGTTGTACTTCAGTTCGGTGGAGGTACAATTGGTC
Centero201   AGCTGTTAGATTATCTTGGTAATGATGTTGTACTTCAGTTCGGTGGAGGTACAATTGGTC
Botry        AGCTGCTAGACTATCTTGGAAACGATGTTGTACTTCAGTTTGGTGGAGGTACAATTGGTC
B.caraibica  AGCTGCTAGACTATCTTGGAAACGATGTTGTACTTCAGTTTGGTGGAGGTACAATTGGTC
Bocci172     AGCTATTAGATTATCTTGGAAATGACGTTGTGCTTCAGTTTGGTGGAGGTACAATTGGTC
B.occid2     AGCTATTAGATTATCTTGGAAATGACGTTGTGCTTCAGTTTGGTGGAGGTACAATTGGTC
B.pyriformis AGCTATTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGTACAATTGGTC
B.ebriosa    AGTTACTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
Bspin        AGTTACTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
Bcana        AGTTACTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
Bskott       AGTTACTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
Bpapen       AGTTACTAGATTATCTTGGAGAGGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
Botryocladia AGTTATTAGATTATCTTGGAGATGATGTTGTACTTCAGTTTGGTGGAGGAACAATTGGTC
B.botryoides AGTTATTAGATTATCTTGGAGATGATGTTGTACTTCAGTTTGGTGGAGGAACAATTGGTC
Bmada        AGTTATTAGATTATCTTGGAGATGATGTTGTACTTCAGTTTGGTGGAGGAACAATTGGTC
Birri224     AGTTACTAGATTATCTTGGAGATGATGTTGTGCTTCAGTTTGGTGGAGGAACAATTGGTC
B.shanskii   AGTTATTAGATTATCTTGGAAATGATGTTGTGCTTCAGTTTGGTGGAGGCACAATTGGTC
B.monoica    AGTTATTAGACTATCTTGGAAATGATGTTGTACTTCAGTTTGGTGGAGGTACAATCGGTC
B.uvarioides AGCTATTAGATTATCTTGGAAATGATGTTGTACTTCAGTTCGGCGGAGGTACAATTGGTC
Rhodymenia   AATTATTAGACTATCTTGGAGATGATGTTGTACTTCAATTTGGTGGCGGTACAATCGGTC
Rhodysp.     AATTATTAGACTATCTTGGAGATGATGTTGTACTTCAATTTGGTGGCGGTACAATCGGTC
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Rpseud       AATTATTAGACTATCTTGGAGATGATGTTGTACTTCAATTTGGTGGCGGTACAATCGGTC
Rdiva240     AGTTATTAGATTATCTTGGCGATGATGTTGTACTTCAATTTGGTGGAGGTACAATTGGTC
E.capensis   AATTGTTAGACTATCTTGGTGATGATGTTGTACTTCAGTTTGGCGGTGGTACAATAGGTC
Epymenia     AATTATTAGATTATCTTGGTGATGATGTTGTACTTCAGTTTGGCGGTGGTACAATAGGTC
E.wilsonis   AATTATTAGATTATCTTGGTGATGATGTTGTACTCCAGTTTGGTGGTGGTACAATAGGTC
Rskott       AATTATTAGATTATCTTGGCAATGATGTTGTACTTCAGTTTGGTGGTGGTACAATAGGTC
R.corallina  AGTTATTAGATTATCTTGGTAATGATGTTGTACTTCAGTTTGGTGGCGGCACAATAGGTC
Cwright      AGTTGTTAGATTATCTTGGAGATGATGTTGTACTTCAGTTTGGCGGTGGTACAATTGGTC
Ch.wrightii  AGTTGTTAGATTATCTTGGAGATGATGTTGTACTTCAGTTTGGCGGTGGTACAATTGGTC
Irvinea      AATTATTGGATTATCTTGGAGAAGATGTTGTGCTTCAGTTTGGTGGTGGTACAATCGGTC
Iboer        AATTATTGGATTATCTTGGAGAAGATGTTGTGCTTCAGTTTGGTGGTGGTACAATCGGTC
Maripelta    AATTATTAGATTACCTTGGAAACGATGTTGTGCTTCAGTTTGGTGGAGGTACAATTGGTC
Cordyle      AACTGCTAGACTATCTTGGTAATGATGTTGTGCTTCAGTTTGGTGGTGGTACAATCGGTC
Halichrysis  A--T--------------------------------------------------------
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Chamaebot232 ACCCAGATGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAAGCAATGGTAA
Chamaebot231 ACCCAGATGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAAGCAATGGTAA
Coelclif235  ATCCAGATGGAATTCAAGCAGGGGCAACAGCTAACCGTGTTCCTTTAGAAACAATGGTAA
C.parvula198 ACCCAGATGGTATCCAGGCAGGTGCAACAGCTAACCGTGTAGCTTTAGAAGCTATGGTAA
C.parvula173 ACCCAGATGGTATCCAGGCAGGTGCAACAGCTAACCGTGTAGCTTTAGAAGCTATGGTAA
Chacompressa ACCCAGATGGTATTCAGGCAGGTGCAACTGCTAACCGTGTAGCTTTAGAAGCAATGGTGA
Champia214N  ACCCAGATGGTATTCAAGCAGGTGCAACTGCTAACCGTGTAGCTTTAGAAGCTATGGTAA
Champia214Na ACCCAGATGGTATTCAAGCAGGTGCAACTGCTAACCGTGTAGCTTTAGAAGCTATGGTAA
Cvieillar221 ATCCTGATGGTATTCAAGCAGGTGCAACTGCTAACCGTGTAGCTTTAGAAGCTATGGTAA
Cvieillar286 ATCCTGATGGTATTCAAGCAGGTGCAACTGCTAACCGTGTAGCTTTAGAGGCTATGGTAA
C.harv177    ATCCTGATGGGATTCAGGCAGGTGCAACAGCTAATCGTGTAGCTCTAGAAGCTATGGTAA
Chharv160    ATCCTGATGGGATTCAGGCAGGTGCAACAGCTAATCGTGTAGCTCTAGAAGCTATGGTAA
Chharv194    ATCCTGATGGGATTCAGGCAGGTGCAACAGCTAATCGTGTAGCTCTAGAAGCTATGGTAA
C.sali161    ATCCTGACGGGATTCAGGCAGGTGCAACAGCTAATCGTGTAGCACTAGAAGCTATGGTAA
chsali195    ATCCTGACGGGATTCAGGCAGGTGCAACAGCTAATCGTGTAGCACTAGAAGCTATGGTAA
Neogastro    ACCCTGATGGTATTCAAGCAGGTGCAACAGCAAATCGTGTAGCTTTAGAAGCTATGGTGA
Neogastro    ACCCTGATGGTATTCAAGCAGGTGCAACAGCAAATCGTGTAGCTTTAGAAGCTATGGTGA
Chylocladia  ATCCAGATGGTATTCAAGCAGGCGCAACAGCTAATCGTGTAGCTTTAGAAGCTATGGTGA
Coelothrix   ATCCAGATGGTATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTGGAAGCTATGGTAA
Coelo215     ATCCAGATGGTATTCAAGCAGGTGCAACAGCTAATCGTGTAGCTTTAGAAGCTATGGTAA
Halymenia    ACCCTGATGGAATTCAAGCAGGAGCAACAGCTAACCGTGTAGCATTAGAAGCTATGGTAA
Lhako        ATCCAGATGGTATACAAGCTGGTGCAACAGCAAATCGTGTAGCTTTGGAATCAATGGTGT
Lhako        ATCCAGATGGTATACAAGCTGGTGCAACAGCAAATCGTGTAGCTTTGGAATCAATAGTGT
Ceratodicti  ACCCAGATGGTATTCAAGCTGGTGCAACAGCAAACCGTGTAGCTTTAGAGTCAATGGTAT
Cerato       ANCCAGATGGTATNCAAGCTGGTGCAACAGCAAANCGTGTAGCTNTAGANTCAATNGTNT
Lcatenata    ACCCAGATGGTATTCAAGCTGGTGCAACAGCAAACCGTGTAGCTCTAGAGTCAATGGTAT
Glioc        ATCCAGATGGAATTCAAGCAGGAGCAACAGCTAATCGTGTAGCTCTAGAATCAATGGTAA
Chagardhii   ATCCAGATGGAATTCAGGCAGGTGCAACAGCTAACCGTGTTGCTTTAGAAGCAATGGTAA
Chprocumbens ATCCAGATGGAATTCAAGCAGGAGCAACAGCAAATCGCGTTGCTTTAGAGGCAATGGTAG
Centero143   ACCCAGATGGAATTCAAGCAGGTGCGACAGCTAACCGTGTTGCTCTAGAAGCAATGGTAA
Centero201   ACCCAGATGGAATTCAAGCAGGTGCGACAGCTAACCGTGTTGCTCTAGAAGCAATGGTAA
Botry        ATCCGGACGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAAGCAATGGTAA
B.caraibica  ATCCGGACGGAATTCAAGCAGGTGCAACAGCTAATCGCGTTGCTTTAGAAGCAATGGTAA
Bocci172     ATCCGGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAAGCAATGGTAA
B.occid2     ATCCGGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAAGCAATGGTAA
B.pyriformis ACCCAGATGGAATTCAAGCAGGTGCTACAGCTAATCGCGTTGCTCTAGAATCAATGGTAA
B.ebriosa    ACCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAAGCAATAGTAA
Bspin        ACCCAGATGGAATTCAAGCAGGTGCTACAGCCAACCG-GTTGC--TAGAA-CAAT-GTAA
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Bcana        ACCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAAGCAATAGTAA
Bskott       ACCCAGATGGAATTCAAGCAGGTGCTACAGATAACGGTGTTGC--TAGAA-CAAT-GTAA
Bpapen       ACCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAAGCAATAGTAA
Botryocladia ATCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTTTAGAATCAATGGTAA
B.botryoides ATCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTTTAGAATCAATGGTAA
Bmada        ACCCAGATGGAATTCAAGCAGGTGCTACAGCTAACCGTGTTGCTCTAGAATCAATGGTAA
Birri224     ATCCAGATGGAATTCAAGCAGGTGCTACAGCTAATCGTGTTGCTTTAGAAGCAATGGTAA
B.shanskii   ATCCAGACGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAAGCAATGGTAA
B.monoica    ATCCAGACGGAATTCAAGCAGGTGCGACAGCTAACCGTGTTGCTCTAGAATCAATGGTAA
B.uvarioides ACCCAGACGGAATTCAAGCAGGTGCGACAGCTAACCGCGTTGCCCTAGAGACAATGGTAG
Rhodymenia   ATCCAGATGGAATTCAAGCGGGTGCAACAGCTAATCGTGTTGCTTTAGAGTCAATGGTAA
Rhodysp.     ATCCAGATGGAATTCAAGCGGGTGCAACAGCTAATCGTGTTGCTTTAGAGTCAATGGTAA
Rpseud       ATCCAGATGGAATTCAAGCGGGTGCAACAGCTAATCGTGTTGCTTTAGAGTCAATGGTAA
Rdiva240     ATCCAGATGGAATTCAAGCAGGTGCAACAGCTAATCGCGTTGCTTTAGAGTCAATGGTAA
E.capensis   ATCCAGATGGAATTCAAGCAGGTGCAACAGCTAACCGCGTTGCTTTAGAGTCAATTGTAA
Epymenia     ATCCAGATGGAATTCAGGCAGGTGCAACAGCTAACCGCGTTGCTTTAGAGTCAATTGTAA
E.wilsonis   ATCCAGATGGAATTCAAGCAGGTGCAACAGCTAACCGCGTTGCTTTAGAGTCAATTGTAA
Rskott       ATCCAGATGGAATTCAAGCAGGTGCAACAGCTAACCGCGTTGCTTTAGAGTCAATAGTAA
R.corallina  ATCCAGATGGAATTCAAGCAGGCGCAACAGCTAACCGTGTTGCTTTAGAGTCAATGGTAA
Cwright      ATCCAGACGGAATTCAGGCAGGTGCGACAGCTAATCGCGTTGCTTTAGAGTCAATAGTAA
Ch.wrightii  ATCCAGACGGAATTCAGGCAGGTGCGACAGCTAATCGCGTTGCTTTAGAGTCAATAGTAA
Irvinea      ATCCAGACGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAGTCAATAGTAA
Iboer        ATCCAGACGGAATTCAAGCAGGTGCAACAGCTAATCGTGTTGCTTTAGAGTCAATAGTAA
Maripelta    ATCCAGATGGAATTCAAGCAGGTGCAACAGCTAACCGTGTTGCTTTAGAGACAATGGTAG
Cordyle      ATCCAGATGGAATTCAAGCAGGCGCAACAGCTAACCGTGTTGCTTTAGAATCAATGGTAA
Halichrysis  ------------------------------------------------------------


Chamaebot232 TAGCGCGGCAAGAAGGACGTGATTATGTGGCTGAAGGCCCACAAATTTTACAAGATGCAG
Chamaebot231 TAGCGCGGCAAGAAGGACGTGATTATGTAGCTGAAGGCCCACAAATTTTACAAGATGCAG
Coelclif235  TAGCACGCAAAGAAGGGCGTGATTATGTAGCGGAAGGGCCACAAATTTTACAAGATGCTG
C.parvula198 TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
C.parvula173 TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
Chacompressa TTGCACGTAACGAAGGACGTGATTACGTAGCTGAAGGACCTCAAATTTTATTTGATGCTG
Champia214N  TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
Champia214Na TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
Cvieillar221 TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
Cvieillar286 TTGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGACCTCAAATTTTACTTGATGCTG
C.harv177    TTGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGACCTCAAATTTTCCCTGATGCTG
Chharv160    TTGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGACCTCAAATTTTCCCTGATGCTG
Chharv194    TTGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGACCTCAAATTTTCCCTGATGCTG
C.sali161    TTGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGACCTCAAATTTTACCTGATGCTG
chsali195    TTGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGACCTCAAATTTTACATGATGCTG
Neogastro    TGGCACGTAATGAAGGTCGCGATTATGTAGCTGAAGGGCCTCAAATTTTACTTGATGCTG
Neogastro    TGGCACGTAATGAAGGTCGCGATTATGTAGCTGAAGGGCCTCAAATTTTACTTGATGCTG
Chylocladia  TAGCACGTAATGAAGGTCGTGATTATGTAGCTGAAGGGCCTCAAATTTTACTTGATGCTG
Coelothrix   TTGCGCGTAATGAAGGTCGTGATTATGTTGCTGAAGGTCCTCAAATTTTACTTGATGCTG
Coelo215     TTGCGCGTAATGAAGGTCGTGATTATGTAGCTGAAGGTCCTCAAATTTTACTTGATGCTG
Halymenia    TTGCACGTAACGAAGGTCGCGATTATGTAGCAGAAGGACCTCAGATCTTACAGGATGCTG
Lhako        TAGCACGCAACGAAGGACGTGATTATGTAGCTGAAGGTCCACAAATCTTACAAGATGCAG
Lhako        TAGCACGCAACGAAGGACGTGATTATGTAGCTGAAGGTCCACAAATCTTACAAGATGCAG
Ceratodicti  TAGCACGTAACGAAGGACGCGATTATGTAGCTGAAGGCCCACAAATTTTACAAGATGCTG
Cerato       TAGCACGNAANGAAGGACGNGATTATGTAGCTGAAGGNCCACAAATTTTACAAGATGCTG
Lcatenata    TAGCACGTAATGAAGGACGTGATTATGTAGCTGAAGGCCCACAAATTTTACAAGATGCTG
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Gloioc       TAGCACGTAATGAAGGTCGTGATTTTGTAGCTGAAGGACCACAAATTTTACAAGATTGTG
Chagardhii   TGGCACGCAACGAAGGGCGTGACTACGTAGGTGAAGGACCTCAAATCTTACAAGATGCTG
Chprocumbens TAGCGCGTAATGAAGGACGTGATTATGTAGCTGAAGGACCACAAATTTTACAAGATGCTG
Centero143   TGGCGCGCAACGAAGGGCGTGATTATGTAGCTGAAGGACCGCAAATTTTACAAGATGCTG
Centero201   TGGCGCGCAACGAAGGGCGTGATTATGTAGCTGAAGGACCGCAAATTTTACAAGATGCTG
Botry        TGGCACGCAATGAAGGGCGTGACTACGTTGCTGAAGGACCACAAATTTTGCAAGATGCCG
B.caraibica  TGGCACGCAATGAAGGGCGTGACTACGTTGCTGAAGGACCACAAATTTTGCAAGATGCCG
Bocci172     TGGCGCGCAATGAAGGGCGTGATTATGTAGCTGAAGGACCACAGATTCTACAAGATGCTG
B.occid2     TGGCGCGCAATGAAGGGCGTGATTATGTAGCTGAAGGACCACAGATTCTACAAGATGCTG
B.pyriformis TAGCGCGTAACGAAGGTCGTGATTATGTAGCTGAAGGACCACAAATTCTACAAGATGCTG
B.ebriosa    TGGCGCGCAACGAAGGGCGTGACTATGTACCTGAAGGACCGCAAATTCTACAAGATGCTG
Bspin        TGGC-CG-AA-GAAGGGCGTGA-TA-GTA---GAAGGACCACAAAT--TACAAGATGC-G
Bcana        TGGCGCGCAACGAAGGGCGTGACTATGTACCTGAAGGACCGCAAATTCTACAAGATGCTG
Bskott       T-GCACG-AA-GAAGG-CGTGA-TA-GTA--TGAAGGACC-CAAAT--T-CA-GATGC-T
Bpapen       TGGCGCGCAACGAAGGGCGTGACTATGTACCTGAAGGTCCGCAAAGTNGNCAAGATGC-G
Botryocladia TGGCGCGCAACGAAGGGCGTGACTATGTAGTTGAAGGACCGCAAATTCTACAAGATGCCG
B.botryoides TGGCGCGCAACGAAGGGCGTGACTATGTAGTTGAAGGACCGCAAATTCTACAAGATGCCG
Bmada        TGGCGCGCAACGAAGGGCGTGACTATGTAGGTGAAGGACCACAAATTCTGCAAGATGCTG
Birri224     TGGCACGCAACGAAGGGCGTGATTATGTAGCTGAAGGACCACAAATTTTACAAGATGCTG
B.shanskii   TGGCGCGTAATGAAGGACGTGATTACGTAGGCGAAGGACCACAAATTTTACAAGATGCTG
B.monoica    TGGCACGCAACGAAGGGCGTGATTACGTAGCTGAAGGACCACAAATTTTACAAGATGCTG
B.uvarioides TGGCGCGCAACGAAGGGCGTGATTACGTAACCGAAGGACCACAAATCTTACAAGATGCCG
Rhodymenia   TGGCGCGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCACAAATTTTACAGAATGCTG
Rhodysp.     TGGCGCGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCACAAATTTTACAGAATGCTG
Rpseud       TGGCGCGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCACAAATTTTACAGAATGCTG
Rdiva240     TGGCGCGCAACGAAGGTCGTGATTATGTAGGTGAAGGACCACAAATTTTACAAAATGCTG
E.capensis   TAGCACGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCGCAAATTTTACAAAATGCTG
Epymenia     TAGCACGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCGCAAATTTTACAAAATGCTG
E.wilsonis   TAGCGCGTAACGAAGGTCGTGATTACGTAGGTGAAGGACCACAAATTTTACAGAATGCTG
Rskott       TAGCGCGTAACGAAGGTCGTGATTACGTAGCTGAAGGACCACAAATTTTACAAAATGCTG
R.corallina  TAGCGCGCAACGAAGGTCGTGATTATGTAGCTGAAGGACCACAAATTTTACAGAATGCTG
Cwright      TAGCGCGTAACGAAGGACGTGATTATGTAGCTGAAGGACCGCAAATTTTACAAGATGCTG
Ch.wrightii  TAGCGCGTAACGAAGGACGTGATTATGTAGCTGAAGGACCGCAAATTTTACAAGATGCTG
Irvinea      TAGCACGCAACGAAGGGCGTGATTACGTAGCTGAAGGACCGCAAAT--TACAAGATGC-G
Iboer        TAGCACGCAACGAAGGGCGTGATTACGTAGCTGAAGGACCGCAAANNTTACAAGATGCCG
Maripelta    TGGCACGCAATGAAGGGCGTGATTATGTTGCTGAAGGACCTCAAATCTTACAAGATGCTG
Cordyle      TAGCACGTAACGAAGGCCGTGATTACGTAGCTGAAGGCCCACAACNNNNACAAAATGCTG
Halichrysis  ------------------------------------------------------------
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Chamaebot232 CTAAGACCTTTGGCCCTCT-------------------------
Chamaebot231 CTAAGACCTGCGGTCCTCT-------------------------
Coelclif235  CTAAAACCTGCGGTCCTCT-------------------------
C.parvula198 CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
C.parvula173 CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Chacompressa CAAAAACTTGCGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Champia214N  CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGGAA
Champia214Na CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGGAA
Cvieillar221 CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Cvieillar286 CAAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
C.harv177    CTAAAACTTGCGGACCTTTACAAACAGCTTTAGATTTATGGGGA
Chharv160    CTAAAACTTGCGGACCTTTACAAACAGCTTTAGATTTATGGGAA
Chharv194    CTAAAACTTGCGGACCTTTACAAACAGCTTTAGATTTATGGGAA
C.sali161    CTAAAACTTGCGGCTCCTTACAAACAGCTTTAGATTTATAGAAA
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chsali195    CTAAAACTTGCAGCACTTTACAAACAGCTTTAGATTTATTGGGA
Neogastro    CTAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Neogastro    CTAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Chylocladia  CTAAAACTTGTGGACCTTTACAAACAGCTTTAGATTTATGGAAA
Coelothrix   CTAAAATCTTTGTCCCTTTACAAACAGCTTTAGATTTATGGAAA
Coelo215     CTAAAACCTTCGTCCCTTTACAAACAGCTTTAGATTTATGGAAA
Halymenia    CAAAAACTTGGGGTCCTTTACAAACAGCTTTAGATTTATGGAAA
Lhako        CTAAAACTTGTGGACCTTT-------------------------
Lhako        CTAAAACTTGTGGACCTTT-------------------------
Ceratodicti  CAAAAACTTGTGGGCCTTT-------------------------
Cerato       CAAAAACTTGTGGGCCTTT-------------------------
Lcatenata    CAAAAACTTGTGGGCCTTT-------------------------
Glioc        CGAAAACTTGTGGACCTTTACAAACAGCTTTAGATCTATGGAAA
Chagardhii   CTAAAACCTGCGGCCCTCT-------------------------
Chprocumbens CTAAAACTTGCGGTCCTCT-------------------------
Centero143   CTAAAACTTGCGGCCCTCT-------------------------
Centero201   CTAAAACTTGCGGCCCTCT-------------------------
Botry        CTAAAACTTGTGGCCCTCT-------------------------
B.caraibica  CTAAAACTTGTGGCCCTCT-------------------------
Bocci172     CTAAAACTTGTGGCCCTCT-------------------------
B.occid2     CTAAAACTTGTGGCCCTCT-------------------------
B.pyriformis CTAAAACTTGCGGACCTCT-------------------------
B.ebriosa    CAAAACCTTG-GG-CCTCT-------------------------
Bspin        CTAA--CTTG-GG-CCTCT-------------------------
Bcana        CTAAAACTTG-GG-CCTCT-------------------------
Bskott       CTAA-ACTTG-GG-CCTCT-------------------------
Bpapen       CTAA-ACTTG-GG-CCTCT-------------------------
Botryocladia CTAAGACTTGTGG-CCTCT-------------------------
B.botryoides CTAAGACTTG-GG-CCTCT-------------------------
Bmada        CTAAAACTTG-GG-CCTCT-------------------------
Birri224     CTAAAACTTGTGGTCCTCT-------------------------
B.shanskii   CTAAAACTTGTGGTCCTCT-------------------------
B.monoica    CTAAAACTTGCGGTCCTCT-------------------------
B.uvarioides CTAAAACTTGCGGTCCTCT-------------------------
Rhodymenia   CTAAAACATGCGGTCCTCT-------------------------
Rhodysp.     CTAAAACATGCGGTCCTCT-------------------------
Rpseud       CTAAAACATGCGGTCCTCT-------------------------
Rdiva240     CTAAAACATGTGGTCCTCT-------------------------
E.capensis   CTAAAACATGCGGTCCTTT-------------------------
Epymenia     CTAAAACATGCGGTCCTCT-------------------------
E.wilsonis   CTAAAACATGCGGTCCTTT-------------------------
Rskott       CTAAAACATGTGGTCCTCT-------------------------
R.corallina  CTAAAACATGTGGTCCTCT-------------------------
Cwright      CTAAAACTTGCGCTCCTCT-------------------------
Ch.wrightii  CTAAAACTTGCGCTCCTCT-------------------------
Irvinea      CCAA--CTTG-GG-CCTCT-------------------------
Iboer        CTAAA-ATTG-GG-CCTCT-------------------------
Maripelta    CGAAAACTTGTGGTCCTCT-------------------------
Cordyle      C-------------------------------------------
Halichrysis  --------------------------------------------
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