Biota Neotropica 24(1): e20231572, 2024
www.scielo.br/bn

biotaneotropica
ISSN 1676-0611 (online edition)

Inventory

Inventory of red algae (Rhodophyta) from the Sian Ka'an Biosphere Reserve, Mexican Caribbean

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MENDOZA-GONZÁLEZ, A.C., MATEO-CID, L.E., HERNÁNDEZ-CASAS, C.M., NAVA-OLVERA, R., MÉNDEZ-GUZMÁN, I., ACOSTA-CALDERÓN, J.A. **Inventory of red algae (Rhodophyta) from the Sian Ka'an Biosphere Reserve, Mexican Caribbean**. Biota Neotropica 24(1): e20231572. https://doi.org/10.1590/1676-0611-BN-2023-1572

Abstract: Studies of marine and estuarine red algae (Rhodophyta) are in the early stages in the littoral of the Sian Ka'an Biosphere Reserve, Mexico. The inventory of these organisms was made based on samples obtained from ten sampling during 2009 to 2015 in 22 localities, eight of them in marine and fourteen in estuarine environments. We found 182 species and subspecific taxa of Rhodophyta. The Rhodomelaceae family was the best represented with 65 taxa, followed by Ceramiaceae 13 and Delesseriaceae 12. Of the 182 taxa, 25 are new records Sian Ka'an Biosphere Reserve with *Harveylithon rupestre, Spongites fruticulosus, Acrochaetium barbadense, Dasya harveyi, Chondria pumila, Spermothamnion repens, Metapeyssonnelia milleporoides* and *M. tangerina* being new records for the Mexican Caribbean. Of the 182 species, 119 of them are epiphytes, most of them, 54, grew exclusively on other macroalgae, 29 on mangrove roots and 8 on *Thalassia* leaves. The floristic list is accompanied by data on seasonality, reproduction, habitat, and environment. Species diversity was compared between the winter rains, dry and rainy seasons during the period study. The Rhodophyta of the Sian Ka'an Biosphere Reserve is tropical, and the greatest diversity was found in the marine environment with 83 taxa and during the winter rains with 132.
Keywords: *Seaweed; marine; estuarine.*

Inventário de algas vermelhas da Reserva da Biosfera Sian Ka'an, Caribe Mexicano

Resumo: Os estudos de algas vermelhas marinhas e estuarinas (Rhodophyta) estão em fase inicial no litoral da Reserva da Biosfera de Sian Ka'na, México. O inventário desses organismos foi feito com base em amostras obtidas em oito amostragens no período do 2009 a 2015 em 22 localidades, sendo oito em ambientes marinhos e quatorze em ambientes estuarinos. Neste levantamento, foram identificadas um total de 182 espécies e táxons subespecíficos de Rhodophyta. A família Rhodomelaceae foi a mais representativa com 65 táxons, seguida por Ceramiaceae com 13 e Delesseriaceae com 12. Dos 182 táxons, 25 são referidos pela primeira vez para a Reserva da Biosfera Sian Ka'an, sendo *Harveylithon rupestre*, *Spongites fruticulosus*, *Acrochaetium barbadense*, *Dasya harveyi*, *Chondria pumila*, *Spermothamnion repens*, *Metapeyssonnelia milleporoides* e *M. tangerina* também novos registros para o Caribe mexicano. Das 182 espécies, 119 são epífitas, sendo a maioria, 54, aderidas exclusivamente em outras macroalgas, 29 em raízes de mangue e 8 em folhas de *Thalassia*. A lista florística apresentada é acompanhada de dados sobre sazonalidade, reprodução, habitat e ambiente. A diversidade de espécies foi comparada entre as temporadas de chuvas de inverno, seca e chuvas de verão durante o período estudado. Rhodophyta da Reserva da Biosfera Sian Ka'an são tropicais, e a diversidade mais representativa foi encontrada no ambiente marinho com 83 táxons e durante as chuvas de inverno com um total de 132 táxons.
Palavras-chave: *Algas; marinhas; estuarinas.*

Introduction

Most of the marine benthic macroalgae are Rhodophyta and there are 7,475 species, which constitutes the highest diversity of all the large groups of macroalgae (Guiry & Guiry 2023). Red algae develop at all latitudes and are found in greater numbers in temperate and tropical, far surpassing the remaining macroalgae groups (García-García et al. 2020, Guiry & Guiry 2023). In addition to their specific richness, the Rhodophyta are primary producers and participate in ecological processes such as recruitment niches, fish and invertebrate nurseries, coralline red algae also are important components of coral reefs (Ceballos-Corona et al. 2019). Mexican Caribbean is one of the shoreline areas having the greatest red seaweeds diversity in Mexico (García-García et al. 2020); however, the area has not been well explored, suggesting that species diversity is not entirely known. The red seaweeds around the Sian Ka'an Biosphere Reserve (RBSK) had been investigated mainly during 1989–1992 and the last contribution was eight years ago. Currently, 168 species of red marine and estuarine algae are reported (Taylor 1972, Aguilar-Rosas et al. 1989, 1992, 1998, Aguilar-Rosas 1990, Keeney 1999, Mendoza-González & Mateo-Cid 2007, Valadez-Cruz et al. 2014, Mateo-Cid et al. 2014, García-García et al. 2020). Now, the marine life of RBSK is threatened due to the overexploitation of natural resources, urbanization, and the other anthropogenic activities (Espejel-Montes 1983, Convención RAMSAR 2003). In this context, the use of marine algae as ecological indicators is essential in monitoring the reserve. However, its application is still not possible due to the absence of a reliable and updated list (Cepeda-González et al. 2007). Therefore, this study complements the knowledge of the three groups of seaweeds (green, brown, and red algae) that inhabit the RBSK, and the goal of this study is to update red algae list with new records and to revise the information of this group in the RBSK, with additional information as distribution, seasonality, environment, reproduction, habitat, epiphytism, and observations.

Material and Methods

Materials, methods, and description of the study area in this work are those described by Acosta-Calderón et al. (2016). Red algae were collected in 22 locations along the RBSK coastline (Figure 1) from March 2009 to April 2015, through ten samplings in three climatic seasons. The specimens were obtained from different substrates that Rhodophyta require for their fixation and development, such as rocks, pebbles, seagrass meadows, mainly *Thalassia testudinum* Banks ex König, mangrove roots, coral skeletons and mollusk remains. The plants were collected by hand with the help of spatulas and field knives at the intertidal level and at the subtidal level by free diving to a depth of four meters. The collections were made in segments of the beaches of approximately 500 m in length. Four samplings were carried out in the rainy season, two

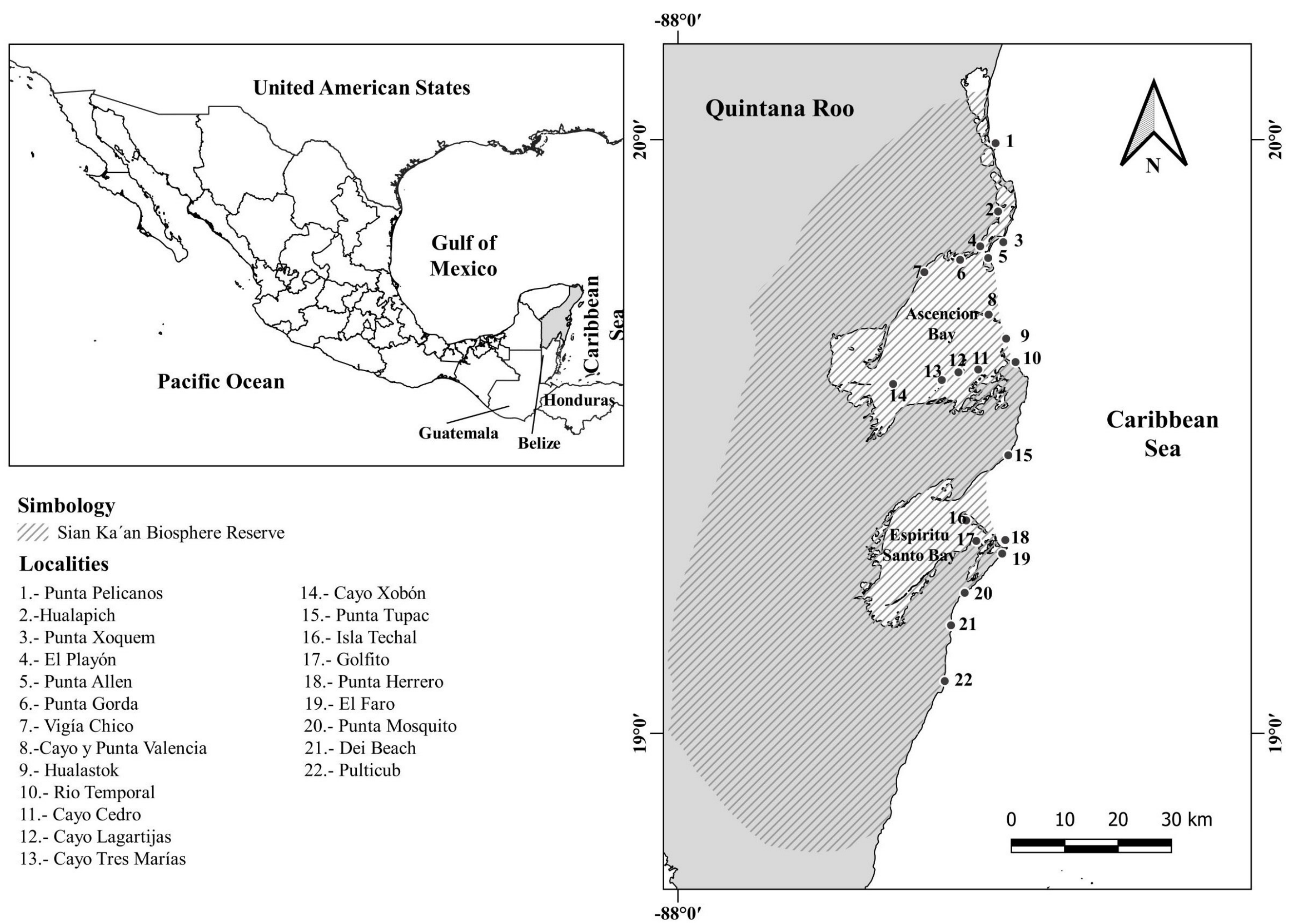

Figure 1. Study area.

in the winter rainy season (Northern) and four in the dry season, data on the GPS coordinates of the localities, substratum, wave exposure, marine or estuarine region, and maximum depth collection of the 22 sampling sites were recorded at Table 1. Specimens of nongeniculate coralline algae were borrowed from ENCB (Departamento de Botánica, Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional, CDMX, Mexico). Additional specimens of nongeniculate coralline algae were collected by reef-walking or snorkeling. Samples were preserved in 5% formalin/seawater for anatomical observations; duplicate samples of some specimens were preserved in silica gel for molecular analyses. Formalin preserved specimens were decalcified with 0.6M HNO_3 and dehydrated with ethyl alcohol at different concentrations: 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and absolute ethyl alcohol (Mateo-Cid et al. 2014). Small fragments were embedded in paraffin and sectioned 9–12 µm thick with a manual microtome, fixed on slides with Riuter's adhesive (Martoja & Martoja-Pierson 1970), and stained with aniline blue and hematoxilin eosine for anatomical observations and measurements. Procedures for morphological observations followed Kato et al. (2006); specimens for molecular analyses were deposited in NCU with duplicates in ENCB. Silica gel-dried samples for DNA

Table 1. Substrate characteristic, wave exposure, region, and maximum depth collection of the 22 sampling sites in the RBSK, Quintana Roo, Mexico. BA: Ascension, BE: Espiritu Santo bays.

No.	Samples sites	Latitude	Longuitude	Characteristics
1	Punta Pelicanos	19°59'38"	87°27'54"	Calcareous rocky with coral fragments and sandy areas with *Thalassia testudinum* meadows. BA outside. Euryhaline. Semi-protected. Subtidal, 0–1.5 m.
2	Hualapich	19°52'44"	87°27'40"	Calcareous rocky and rocks of different size. BA outside. Euryhaline. Exposed. Subtidal, 0–1 m.
3	Punta Xoquem	19°49'37"	87°27'08"	Rocky platform that extends from the intertidal zone to the subtidal zone where it is interspersed with sandy areas associated with *T. testudinum*. BA outside. Euryhaline. Exposed Intertidal-Subtidal 1.5 m.
4	El Playón	19°49'13"	87°29'28"	Sandy-muddy with shell fragments. Inside BA. Brackish. Protected. Subtidal 0-1 m.
5	Punta Allen	19°48'02"	87°28'39"	Sandy with *T. testudinum* meadows and wood dock. The shore is covered by *Rhizophora mangle*. Outside BA. Euryhaline. Protected. Subtidal 0–2 m.
6	Punta Gorda	19°47'51"	87°31'30"	Sandy with shell and coral fragments. The shore is covered by *R. mangle*. Inside BA. Brackish. Protected. Subtidal 0–1 m.
7	Vigía Chico	19°46'36"	87°35'07"	Muddy with *T. testudinum* patches and *R. mangle* in shore. Inside BA: Brackish. Protected. Subtidal 0–1 m.
8	Cayo Valencia	19°42'19"	87°28'37"	Sandy with *T. testudinum* meadows and *R. mangle*. Outside BA. Euryhaline. Semi-protected. Subtidal 0–1.5 m.
9	Hualastok	19°39'52"	87°26'51"	Sandy with *T. testudinum* meadows. Outside BA. Euryhaline. Semi-protected. Subtidal 0–3 m.
10	Rio Temporal	19°37'31"	87°25'54"	Sandy and calcareous rocky (0–2 m depth) and sandy with *T. testudinum* meadows (>2 m). Outside BA. Euryhaline. Semi-protected. Subtidal 0–4 m.
11	Cayo Cedro	19°36'46"	87°29'40"	Sandy with shell and coral fragments. *R. mangle* at shore. Inside BA. Brackish. Protected. Subtidal 0–1 m.
12	Cayo Lagartijas	19°36'29"	87°31'40"	
13	Cayo Tres Marías	19°35'42"	87°33'21"	
14	Cayo Xobón	19°35'17"	87°38'16"	
15	Punta Túpac	19°28'05"	87°26'38"	Rocky platform, rock of different size and sandy areas with *T. testudinum* meadows. *R. mangle* at shore. Outside BE. Euryhaline. Semi-protected. Subtidal 0–1.5 m
16	Isla Techal	19°21'31"	87°30'53"	Sandy-muddy with *T. testudinum* patches and *R. mangle*. Outside BE. Euryhaline. Protected. Subtidal 0–1.5 m.
17	Golfito	19°19'26"	87°29'52"	Muddy-sandy with shell fragments and *R. mangle* at shore. Inside BE. Brackish. Protected. Subtidal 0–1.5 m
18	Punta Herrero	19°19'32"	87°26'56"	Sandy-muddy with *T. testudinum* meadows. Outside BE. Euryhaline. Semi-protected-Subtidal 0–1.5 m.
19	El Faro	19°18'09"	87°27'14"	Rocky platform and sand areas with *T. testudinum* patches. Outside BE. Exposed. Euryhaline. Intertidal and Subtidal 0–4 m.
20	Punta Mosquitero	19°14'12"	87°31'02"	Sandy with *T. testudinum* patches and calcareous rocky of different sizes. Outside BE. Euryhaline. Semi-protected. Subtidal 0–1.5 m.
21	Playa Dei	19°10'54"	87°32'25"	Sandy with *T. testudinum* patches and calcareous rocky of different sizes. Outside BE. Euryhaline. Exposed. Subtidal 0–1.5 m.
22	Pulticub	19°05'17"	87°33'03"	Rocky platform with limestone and *T. testudinum* patches. Outside BE. Euryhaline. Exposed. Intertidal and Subtidal 0–1.5 m.

extraction were examined under high magnification with a dissecting microscope to check for red algal epiphytes. Clean fragments about 3 mm^3 total volume were placed in heavy paper packets and crushed and ground to a fine powder before being extracted following the protocol in Hughey et al. (2001) and the recommendations in Hughey & Gabrielson (2012). For DNA sequencing of collected specimens, markers chosen for PCR included the chloroplast-encoded genes *rbc*L, *psb*A as well as COI, and LSU (Richards et al. 2021). DNA was extracted from globally collected specimens at the University of North Carolina at Chapel Hill following the protocol established by Hughey et al. (2001) and modified by Gabrielson et al. (2011) for coralline algae. Amplification of *psb*A, *rbc*L, UPA, COI, and LSU followed the protocols and primers described in Richards et al. (2014, 2016). Voucher specimens are deposited in the herbarium of the Escuela Nacional de Ciencias Biológicas located in Mexico City, Mexico (ENCB), herbarium acronym follows Index Herbariorum (Thiers 2023). Also, information on species previously collected by other researchers was obtained of the herbarium ENCB; the determinations of some specimens were corrected and finally a bibliographic review of the studies carried out in the SKBR from 1989 to 2015, to obtain the records of Rhodophyta previously cited for the coast of the state and thereby compare it with the data obtained in the present study. To describe the geographical distribution of marine algae, Feldmann (1937) proposed the R/P index (number of Rhodophyta species divided by number of Phaeophyceae species), useful for knowing the geographical areas where algae are distributed and thus classifying the flora of a given region as a function of the latitudinal gradient. Thus, a value of the ratio $R/P > 4$ is found in tropical regions, while $R/P < 2$ corresponds to the phycoflora of temperate-cold regions. Cheney (1977) included the Chlorophyta (C) in an index like the one previously exposed $(R + C)/P$ and showed that values of the ratio $(R + C)/P \geq 6$ are obtained in tropical floras, while those from temperate-cold seas have indices <3, intermediate values suggest a mixed flora. The floristic list is accompanied by data on distribution, seasonality, environment, reproduction, habitat, observations, and herbarium number, new records for the RBSK and for Mexican Caribbean are indicated in Table 2. Species names are according to Wynne (2022) and Guiry & Guiry (2023).

Results

1. Floristics

During the study period (March 2009 to April 2015), 182 Rhodophyta taxa distributed in 4 classes, 15 Orders, 30 Families and 83 genera were determined (Table 2). The best represented Order was Ceramiales with 104 taxa (57.1%) followed by Corallinales with 29 (15.9%). The best represented families were Rhodomelaceae with 65 taxa (35.7%), followed by Ceramiaceae 13 (7.1%), Delesseriaceae with 12 (6.6%) and Spongitidaceae 10 (5.4%). Species of Bangiaceae, Liagoraceae, Galaxauraceae, Gelidiaceae, Cystocloniaceae, Peyssonneliaceae and Gracilariaceae represented by 1 or 5 species were also located (Table 2). The most representative genera in terms of the number of species were *Chondria* with 12, *Neogoniolithon* and *Laurencia* with 9 each, *Ceramium, Dasya* and *Polysiphonia* with 8 each. *Bangia, Asparagopsis, Lithothamnion, Melobesia, Wrightiella, Vertebrata, Gelidium* and *Gelidiella,* among others, are unispecific. The Rhodophyta determined in this work have been recorded in the tropical and temperate rocky areas of the world, including the coast of the Gulf of Mexico and the Mexican Caribbean (Wynne 2022, García-García et al. 2020). Considering previous studies of the studies of Acosta-Calderón et al. (2016) and Mateo-Cid et al. (2019) who listed the Chlorophyta and Phaeophyceae, respectively, from the RBSK, the Feldmann and Cheney indexes were calculated and compared with other localities and states of the Yucatan Peninsula (Table 3). Both the Feldmann and Cheney indices indicate that the RBSK phycoflora is of tropical affinity.

2. New records

The integration of the floristic list allowed us to recognize 25 new infrageneric records for the RBSK coastline, including *Harveylithon rupestre, Spongites fruticulosus, Acrochaetium barbadense, Dasya harveyi, Chondria pumila, Spermothamnion repens, Metapeyssonnelia milleporoides* and *M. tangerina*, representing new records for the Mexican Caribbean. Of the 168 previous infrageneric records, 116 taxa were found in this study and 51 were not found in the collected samples. Due to the above, the number of species recorded for the coast of the Sian Ka'an Biosphere Reserve increased to 233 infrageneric taxa of benthic marine and estuarine red algae, which represents an increase of 28% of the total Rhodophyta in the study area. Most of the new records for RBSK belong to genera of coralline algae and the Rhodomelaceae family such as *Chondria* and *Laurencia*.

3. Temporal variation

Figure 2 represents the number of taxa identified by climatic season, in general we can observe high richness in the three seasons, being in winter rains (northern) when the highest specific richness was located with 132, followed by rainy, 122 and finally dry with 107 taxa. Figure 3 shows the number of taxa per locality, it is observed that the locality corresponding to Punta Pelícanos presented the greatest richness (96 taxa), followed by Punta Xoquem (49) and Hualapich (45). The three localities have in common the fact of being found in a marine environment and be rocky beaches. The localities with the lowest specific richness are Golfito (11), Punta Allen and Golfito (10) and Punta Mosquitero (7), the first three are in an estuarine environment and only Punta Mosquitero is in a marine environment.

The number of taxa found in the different environments is represented in Figure 4, where it is observed that the highest species richness was found in the marine environment with 83 taxa, while in the estuarine environment 34 and 65 were found inhabiting in both marine and estuarine environments (Table 2).

4. Reproduction

The reproductive phase that was found most frequently in this study was the tetrasporic, which exceeded both the algae found with male or female gametic phase. These data allow us to consider that this generation has a longer survival with respect to the gametophytic generation, and other reproductive mechanisms such as vegetative propagation or apomeiosis. From the 182 taxa located in this study, 92.3% (168) were found in the fertile stage and only 7.6% (14) were found in the vegetative state, the sporophytic phase was found in 153 taxa, the gametophytic phase exclusively in 12 and finally 44 taxa

Table 2. Rhodophyta of the Sian Ka'an Biosphere Reserve, Quintana Roo (2009–2015). (The abbreviations are explained at the end of the table).

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
RHODOPHYTA									
Bangiophyceae **Bangiales** **Bangiaceae**									
1. *Bangia fuscopurpurea* (Dillwyn) Lyngbye	15	N	M		Ve		Epi/Sw		26451
Florideophyceae **Corallinales** **Corallinaceae**									
2. *Jania capillacea* Harvey	1, 2, 3, 6, 8, 10, 11, 13, 17, 19	Ll N S	M, E	Te	Te	Te	Epi/Sw Epi/Th R		20068 20296 20655 20656 21321 21322 21323 24986 26233 26234 26235 26408 26453 26465 26548 26579
3. *J. cubensis* Montagne ex Kützing	3, 5, 11	N S	M, E		Te	Te	Epi/Sw R		20069 26236 26452
4. *J. pedunculata* var. *adhaerens* (J.V. Lamouroux) A. S. Harvey, Woelkerling & Reviers	1, 11, 13	Ll N S	M, E	Te	Te	Te	Epi/Sw R		26237 26551 26552 26553
5. *J. rubens* (Linnaeus) J.V. Lamouroux	1, 12	Ll N	M, E	Te	Te		R		20133 21335
6. *Pneophyllum confervicola* (Kützing) Y.M. Chamberlain	3, 8, 14, 15, 19, 20, 22	Ll N S	M	Te Ci ♀ ♂	Te Ci ♂	Te Ci ♂	Epi/Th Epi/Sw		19638 20280 20171 23345 26549 26550 26575 26605
7. *P. fragile* Kützing	1, 3, 8	Ll N S	M	Te	Te Ci ♀ ♂	Te	Epi/Th Epi/Sw		20164 23348 26196 26576 26577 26578
Hydrolithaceae									
8. *Hydrolithon boergesenii* (Foslie) Foslie	1	Ll	M	Te			R Ez		17785
9. *H. farinosum* (J.V. Lamouroux) Penrose & Y.M. Chamberlain	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22	Ll N S	M, E	Te Ci ♂	Te Ci ♀ ♂	Te Ci ♀ ♂	Epi/Sw Epi/Th		19327 19638 19835 19839 19958 20280 20859 20866 20935 21544 23242 23369 23567 23616 23623 23641 24671 24954 26229 26422 26424 26425 26473 26474 26475 26476 26477 26478 26500 26525 26555 26556 26563 26574 26575 26581

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
Lithophyllaceae									
10. *Amphiroa fragilissima* (Linnaeus) J.V. Lamouroux	1, 2, 7, 8, 11, 14, 19, 21, 22	Ll N S	M, E	Te	Ve	Ve	Epi/Sw R		17924 19344 19921 19922 20305 20793 20799 20815 26479 26480 26481 26482 26582
11. *A. rigida* J.V. Lamouroux	1, 2, 3, 5, 9, 15, 19, 20, 21, 22	Ll N S	M	Ci	Ve	Ve	R		18287 19258 19310 19311 19794 19918 19922 19928 19930 20060 20297 20653 20767 20772 20774 20801 20804 20805 26483 26484 26485
12. *A. tribulus* (J. Ellis & Solander) J.V. Lamouroux	1, 2, 3, 15, 19, 20, 21, 22	Ll N S	M	Ve	Ve	Ve	R Ez		19926 19932 20297 20638 20796 20797 22830 26486
13. *A. valonioides* Yendo	1	N	M		Te		Epi/Sw		20063
14. *A. vanbosseae* Me. Lemoine	1	S	M			Ve	R		19916 20058
15. *Lithophyllum corallinae* (P. Crouan & H. Crouan) Heydrich	15	N	M		Te		Ez		20145
16. *Titanoderma pustulatum* (J.V. Lamouroux) Nägeli	5, 9, 14, 15, 18, 20, 22	Ll N S	M, E	Te	Te	Te	Epi/Sw		19348 19638 23456 26452 26556 26584 26601
Porolithaceae									
17. *Harveylithon munitum* (Foslie & M. Howe) A. Rösler, Perfectti, V. Peña & J.C. Braga	1, 2	Ll N	M	Te	Te		R		20079 20080 20134 26188
18. *H. rupestre* (Foslie) A. Rösler, Perfectti, V. Peña & J.C. Braga	15	N	M		Te		Ez	**NRMC**	26228
19. *Porolithon antillarum* (Foslie & M. Howe) Foslie & M. Howe	1	N	M		Te		Ez	NRSK	26230
20. *P. onkodes* (Heydrich) Foslie	1	N	M		Te Ci ♀ ♂		Ez	NRSK	26189
Spongitidaceae									
21. *Neogoniolithon acropetum* (Foslie & M. Howe) W.H. Adey	1, 2, 3	Ll N S	M	Te	Te	Te	Ez R		19933 20131 20224 20263 20288 21442

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https://doi.org/10.1590/1676-0611-BN-2023-1572

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
22. *N. fosliei* (Heydrich) Setchell & L.R. Mason	1	N	M		Te		Epi/Sw		20086
23. *N. mamillare* (Harvey) Setchell & L.R. Mason	1	Ll	M	Te			R		26190
24. *N. propinquum* (Foslie) Me. Lemoine	1, 2, 3, 22	Ll N S	M	Te Ci ♀	Te	Te	R		20081 20306 26191 26192
25. *N. rhizophorae* (Foslie & M. Howe) Setchell & L.R. Mason	1, 13	N	M, E		Te		Ez		26193 26232
26. *N. siankanense* L.E. Mateo-Cid, A.C. Mendoza-González & P.W. Gabrielson	1, 2	Ll S	M	Te		Te	R		20159 20225 20306
27. *N. solubile* (Foslie & M. Howe) Setchell & L.R. Mason	15, 22	N S	M		Te	Te	Ez		22395 26194
28. *N. spectabile* (Foslie) Setchell & L.R. Mason	1, 3, 7, 9, 10, 15, 22	Ll N S	M, E	Te	♂	Te	Ro		17920 19220 19750 19799 19914 20082 20132 20141 21447 22832
29. *N. strictum* (Foslie) Setchell & L.R. Mason	1,8, 10, 15, 19, 21, 22	Ll N S	M, E	Te	Ve	Te	Ro		19802 19803 19855 19915 19920, 19929 20142
30. *Spongites fruticulosus* Kützing	1	N	M		Te		Ez	**NRMC**	26195
Hapalidiales									
Hapalidiaceae									
31. *Lithothamnion sejunctum* Foslie	1	N	M		Te		Ez	NRSK	20073
32. *Melobesia membranacea* (Esper) J.V. Lamouroux	8, 15, 17	Ll S	M, E	Te		Te	Epi/Th		20090 20097 20171 21691
Acrochaetiales									
Acrochaetiaceae									
33. *Acrochaetium barbadense* (Vickers) Børgesen	1	S	M			Mn	Epi/Sw	**NRMC**	26281
Colaconematales									
Colaconemataceae									
34. *Colaconema daviesii* (Dillwyn) Stegenga	1	N	M		Mn		Epi/Sw		26280
35. *C. hypneae* (Børgesen) A.A. Santos & C.W.N. Moura	2	Ll	M	Mn			Epi/Sw		26366
Nemaliales									
Galaxauraceae									
36. *Galaxaura rugosa* (J. Ellis & Solander) J.V. Lamouroux	1, 2, 3, 18, 19, 22	Ll N S	M	♂	♂	Ci	R		19679 20300 20580 20639 20697 25036 26471 26472 26557 26558 26559

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
Liagoraceae									
37. *Ganonema farinosum* (J.V. Lamouroux) K.-C. Fan & Y.-C. Wang	1, 3, 15, 22	Ll N S	M	Ci ♂♀	Ci ♂♀	♂♀	R		23220 24922 26281 26282 26500
38. *G. megagynum* (Børgesen) Huisman	1, 3, 22	Ll N S	M	Ci ♀	♂	Ci ♀	R		23309 23310 26283 26284 26285 26604
39. *Gloiocallis dendroidea* (P. Crouan & H. Crouan) Showe M. Lin, Huisman & D.L. Ballantine	1, 22	Ll N	M	♀	Ci ♀		R		23314 26286 26287
40. *Liagora ceranoides* J.V. Lamouroux	1,2, 3, 22	Ll N S	M	♂	♂	♂♀	R		23312 23313 26288 26289 26517
41. *Titanophycus validus* (Harvey) Huisman, G.W. Saunders & A.R. Sherwood	3, 22	S	M			Ci ♀	R	NRSK	20959 26292
42. *Trichogloeopsis pedicellata* (M. Howe) I.A. Abbott & Doty	4, 22	Ll N	M	Ci ♀	♂		R		26290 26291
Bonnemaisoniales									
Bonnemaisoniaceae									
43. *Asparagopsis taxiformis* (Delile) Trevisan	1, 11, 18, 19	N	M, E		Te		Epi/Sw		20114 22841 26266 26406
Ceramiales									
Callithamniaceae									
44. *Callithamnion corymbosum* (Smith) Lyngbye	8	Ll	E	Te Ci			Epi/Mg		26239
45. *Crouania attenuata* (C. Agardh) J. Agardh	1, 2, 3, 8	S	M, E			Te	Epi/Sw		20963 26384
46. *Crouanophycus latiaxis* (I.A. Abbott) A. Athanasiadis	3, 9, 10, 18	Ll N	M, E	Te	Te		Epi/Th Epi/Sw		20456 21002 21355 26507
47. *Spyridia aculeata* subsp. *complanata* (J. Agardh) Hommersand	1, 2	Ll S	M	Te		Te	R	NRSK	21082 26240
48. *S. filamentosa* (Wulfen) Harvey	6, 7, 8, 11	Ll N	E	Te ♂	Te Ci		Epi/Sw R		23274 23275 26241 26242 26243
49. *S. hypnoides* (Bory) Papenfuss	1, 2, 8	Ll N	M, E	Ve	Ve		Epi/Sw R		20932 21082 26244
Ceramiaceae									
50. *Centroceras gasparrinii* (Meneghini) Kützing	1, 2, 6, 8, 11, 14, 15	Ll N	M, E	Ci Te	Te		Epi/Mg Epi/Th Epi/Sw R	NRSK	26245 26246 26247 26393 26463 26509 26510
51. *C. hyalacanthum* Kützing	2	Ll	M	Te			Epi/Sw	NRSK	26400

Continue...

...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
52. *C. micracanthum* Kützing	1, 8, 15, 19, 22	Ll N S	M	Te Ci	Te	Te	Epi/Sw R		19840 20113 22840 23277 23278 23279 26368 26510
53. *Ceramium brevizonatum* H.E. Petersen	12, 13	Ll S	E	Te		Te	Epi/Mg R		26248 26385
54. *C. brevizonatum* var. *caraibicum* H.E. Petersen & Børgesen	2, 6, 9, 11, 13, 15, 19	Ll N S	M, E	Te	Te Ci ♂	Te	Epi/Sw R		20695 26249 26430 26502 26510 26523 26562 26609
55. *C. cimbricum* f. *flaccidum* (H.E. Petersen) G. Furnari & Serio	8, 9, 18	Ll S	E	Te		Ve	Epi/Sw		20714 26502 QROO-12-89/03
56. *C. comptum* Børgesen	12	S	E			Te	Epi/Mg	NRSK	19783
57. *C. corniculatum* Montagne	2, 7, 8	Ll N S	M, E	♂ Ci	Te	Te	Epi/Th Epi/Mg R		20589 23276 26250
58. *C. cruciatum* Collins & Hervey	8, 15, 18	Ll N S	M	Te Ci	Te	Te	Epi/Sw Epi/Mg		19638 22845 26251
59. *C. luetzelburgii* O.C. Schmidt	10, 19, 22	Ll	M	Te			Epi/Sw		20706 26609 QROO-Rh/01
60. *C. nitens* (C. Agardh) J. Agardh	1, 2, 3, 6, 8, 9, 10, 22	Ll N S	M, E	Ve	Te	Ve	Epi/Th Epi/Sw R		26394 26396 26397 26467 26468 26497 26498 26499 26511 26512 26513
61. *Gayliella flaccida* (Harvey ex Kützing) T.O. Cho & L.J. McIvor	9, 15, 20	Ll N	M	Te		Te	Epi/Sw		19348 19638 23840
62. *G. transversalis* (Collins & Hervey) T.O. Cho & Fredericq	1, 3, 15, 22	Ll N	M	Te	Te		Epi/Mg Epi/Sw		19638 26386 26387 26471 26495
Delesseriaceae									
63. *Caloglossa leprieurii* (Montagne) G. Martens	6, 8, 16	Ll N S	E	Te	Te	Ve	Epi/Mg		24907 24908 26257
64. *Dasya baillouviana* (S.G. Gmelin) Montagne	2	Ll N	M	Te	Ve		R		23301
65. *D. caraibica* Børgesen	3	S	M			Ve	Epi/Mg R		26258
66. *D. collinsiana* M. Howe	3, 8	N S	M		Ve	Ve	Epi/Sw	NRSK	20926 26259
67. *D. corymbifera* J. Agardh	2	S	M			Te	Epi/Mg R		23300
68. *D. harveyi* Ashmead	1, 3	N	M		Te		R	**NRMC**	26260 26261
69. *D. ocellata* (Grateloup) Harvey	9	Ll	M	Te			Epi/Sw	NRSK	19348
70. *D. ramosissima* Harvey	1	Ll N	M	Te	Te		R Epi/Sw	NRSK	26262 26263 26264
71. *D. rigidula* (Kützing) Ardissone	7, 8	Ll N S	M, E	Te	Te	Te	Epi/Mg		20847 22446 23302 26265
72. *Heterosiphonia crispella* (C. Agardh) M.J. Wynne	1, 11, 18, 19	Ll N S	M, E	Te ♂	Ve	Ve	Epi/Sw		20396 23588 23627 26266
73. *Heterosiphonia crispella* var. *laxa* (Børgesen) M.J. Wynne	1, 2	Ll N	M	Te	Te		Epi/Sw		26515 26566

Continue...

...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
74. *H. gibbesii* (Harvey) Falkenberg	1, 2, 3, 8, 9, 10, 18, 19	Ll N S	M, E	Te	Te	Te ♂	R		20984 23215 23297 23298 23299 24904 26267 26268 26269 26398 26399 26400
Rhodomelaceae									
75. *Acanthophora muscoides* (Linnaeus) Bory	1, 18	S	M			Ci	R		20934 23223 26401
76. *A. spicifera* (M. Vahl) Børgesen	1, 3, 8, 11, 15, 18	Ll N S	M, E	Te	Te	Te Ci	Epi/Mg R		19785 20588 20929 23221 23222 23318 24924 26437 26438 26439 26440
77. *Acanthosiphonia echinata* (Harvey) Savoie & G.W. Saunders	1	N	M		Te ♂Ci		R		25086
78. *Alsidium seaforthii* (Turner) J. Agardh	1	Ll	M	Ve			R		26518
79. *A. triquetrum* (S.G. Gmelin) Trevisan	1, 3	Ll N S	M	Te	Te	Ve	Epi/Mg R		23323 26375 26519
80. *Bostrychia binderi* Harvey	7	Ll	E	Te			Epi/Mg		26294
81. *B. montagnei* Harvey	5, 7, 8, 12	Ll N S	E	Te	Ve	Te Ci	Epi/Mg		20155 20958 23321 24925 26295
82. *B. moritziana* (Sonder ex Kützing) J. Agardh	5	N	E		Te		Epi/Mg		26296
83. *B. radicans* (Montagne) Montagne	11	N	E		Te		Epi/Mg		26297
84. *B. scorpioides* (Hudson) Montagne	4, 6, 7, 11	Ll N	E	Te	Ci		Epi/Mg		23322 26298 26441 26442 26520
85. *B. tenella* (J.V. Lamouroux) J. Agardh	1, 6, 7, 8, 11, 12, 19	Ll N S	M, E	Te	Te	Te Ci	Epi/Mg R		19907 24926 24927 24928 26443 26444 26445 26446
86. *Chondria atropurpurea* Harvey	7, 10	Ll S	E	Te		Te	Epi/Mg Epi/Sw Ez		23324 26560
87. *Ch. baileyana* (Montagne) Harvey	1, 8, 13, 18	Ll N S	M, E	Ci	Te	Te Ci ♂	Epi/Th R		19790 24929 26424 26564
88. *Ch. capillaris* (Hudson) M.J. Wynne	4, 9, 10	Ll N	E	Te	Ci		Epi/Mg Epi/Sw R		23225 26299 QROO-11-39/02
89. *Ch. cnicophylla* (Melvill) De Toni	2, 6, 17	Ll S	M, E	Te		Te	Epi/Mg R		20234 24930 26302 26523
90. *Ch. collinsiana* M. Howe	1, 6, 7, 9, 10, 12, 19	Ll N S	M, E	Te ♂ Ci	Te	Te Ci	Epi/Mg Epi/Th R		19834 19921 21042 23325 23326 26300 26301 26521

Continue...

...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
91. *Ch. dasyphylla* (Woodward) C. Agardh	4, 6, 7, 11, 12, 13, 18, 19	Ll N S	M, E	Te	Te	Te	Epi/Mg Epi/Sw R		20116 22846 23226 23328 24932 26304 26305 26306 26587
92. *Ch. floridana* (Collins) M. Howe	19	Ll	M	Te			R		24931
93. *Ch. leptacremon* (Melvill ex G. Murray) De Toni	10, 19	Ll	M, E	Te			R	NRSK	24933 24934 26307
94. *Ch. littoralis* Harvey	1, 3, 7, 9	N S	M, E		Te	Te	R		20154 20931 23227 23329 23330 26308 26309
95. *Ch. polyrhiza* Collins & Hervey	8, 10, 19	Ll S	E	Te		Te	Epi/Th		21607 RhC-12/01, 02
96. *Ch. pumila* Vickers	5	N	E		Te		Epi/Sw	**NRMC**	26310
97. *Ch. pygmaea* Garbary & Vandermeulen	3	N	M		Te		Epi/Th		26522
98. *Chondrophycus anabeliae* Senties, M.T. Fujii, Cassano & Dreckmann	1	N	M		♂		R	NRSK	26311
99. *Digenea mexicana* G.H. Boo & D. Robledo	1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 17, 22	Ll N S	M, E	Te	Te	Te Ci	Epi/Mg R		17732 20314 22462 23331 23332 24935 26447 26448 26449 26450 26451 26452 26488 26523 26524 26525 26526 26565 26566
100. *Dipterosiphonia dendritica* (C. Agardh) F. Schmitz	1	N	M		Te		Epi/Sw		26527
101. *D. rigens* (C. Agardh) Falkenberg	18, 19	Ll	M	Te Ci ♀			Epi/Sw	NRSK	26312 26528
102. *Herposiphonia bipinnata* M. Howe	6, 10, 11, 12, 13, 18	Ll N S	M, E	Te	Ve	Te Ci ♂	Epi/Th Epi/Sw		19702 20027 21536 26313 26314 26425 26529
103. *H. pecten-veneris* (Harvey) Falkenberg	6, 10, 13	Ll N S	E	Te	Ve	Te	Epi/Mg Epi/Th Epi/Sw R		26315 26316 26317 26530
104. *H. secunda* (C. Agardh) Ambronn	1, 9, 19, 21	Ll N S	M	Te	Te	Te	Epi/Sw		20907 23518 26318 26319 26418 26606
105. *H. tenella* (C. Agardh) Ambronn	1, 7, 8, 10, 11, 15, 18, 19, 22	Ll N S	M, E	Te Ci	Te	Ci	Epi/Sw Pe		19702 19844 20114 20373 20417 20706 20819 20997 20112 24749
106. *Heterodasya mucronata* (Harvey) M.J. Wynne	1	N	M		Te		R		26320

Continue...

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...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
107. *Laurencia caduciramulosa* Masuda & S. Kawaguchi	3	N	M		Te		Ez	NRSK	26321
108. *L. caraibica* P.C. Silva	1	Ll N	M	Te	Te		R		26322 26323
109. *L. dendroidea* J. Agardh	7, 10, 19	Ll N S	M, E	Te	Ve	Te	Epi/Sw R		22463 26324 26325
110. *L. filiformis* (C. Agardh) Montagne	3, 6, 7, 9, 10, 11	Ll N S	M, E	Te	Te	Te	Epi/Sw R		19782 20314 23378 23379 23380 26326 26588
111. *L. intricata* J.V. Lamouroux	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19	Ll N S	M, E	Te	Te	Te	Epi/Th Epi/Mg Epi/Sw		20117 20118 20966 23231 23232 23384 24936 23388 23390 26453 26454 26455 26456 26457 26458 26459 26460 26461 26462 26489 26531 26561 26567
112. *L. laurahuertana* Mateo-Cid, Mendoza-González & Senties	3	N	M		Te		Epi/Th		26327
113. *L. microcladia* Kützing	1, 7, 8, 18, 19, 21, 22	Ll N S	M, E	Te Ci	Te	Te	Epi/Sw Epi/Th R		20443 23391 24937 26328 26407 26532 26533 26589
114. *L. obtusa* (Hudson) J.V. Lamouroux	1, 2, 3, 7, 8, 17, 18, 19, 21, 22	Ll N S	M, E	Te Ci	Te	Te	R		20313 20963 20964 23233 23392 23393 24938 26402 26403 26404 26405 26406 26534 26535 26568 26569 26590 26591
115. *L. venusta* Yamada	1, 10, 16, 17, 18	Ll S	M, E	Te		Te	Epi/Sw R		23234 26536 26570
116. *Laurenciella marilzae* (Gil-Rodríguez, Sentíes, Díaz-Larrea, Cassano & M.T. Fujii) Gil-Rodríguez, Sentíes, Díaz-Larrea, Cassano & M.T. Fujii	1, 12	Ll N	M, E	Te	Te		R	NRSK	23377 26333
117. *Lophocladia trichoclados* (C. Agardh) F. Schmitz	1, 2, 3, 22	Ll N S	M	Te	Te	Te	Epi/Sw R		23400 26329 26330 26331 26332 26537 26541
118. *Lophosiphonia cristata* Falkenberg	3	S	M			Te	Epi/Sw		26334

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...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
119. *L. obscura* (C. Agardh) Falkenberg	1	Ll N	M	Te	Ve		Epi/Sw		25085 26335
120. *Melanothamnus ferulaceus* (Suhr ex J. Agardh) Díaz-Tapia & Maggs	1, 3, 6, 9, 19	Ll N S	M, E	Te Ci	Te	Te Ci	Epi/Sw R		20709 20961 23398 24939 26336 26337 26338 26491
121. *M. sphaerocarpus* (Børgesen) Díaz-Tapia & Maggs	1, 2, 7, 12, 15, 16	Ll N S	M, E	Te Ci	Te Ci	Te	Epi/Th Epi/Mg Epi/Sw R		20762 24940 24941 24942 26339 26340 26341
122. *Meridiocolax polysiphoniae* (E.C. Oliveira & Ugadim) J. Morrill	7, 19	Ll	M, E	Te Ci ♂			Par		QR12A/01 QR08B/02.
123. *Murrayella periclados* (C. Agardh) F. Schmitz	8, 11, 13, 14	Ll N S	E	Te	Te	Te	Epi/Mg R		23399 24943 26408 26409 26410 26538
124. *Palisada corallopsis* (Montagne) Sentíes, Fujii & Díaz-Larrea	4, 5, 11, 14, 19	Ll N	M, E	Te	Te		Epi/Mg R		24944 26342 26343 26411 26412
125. *P. flagellifera* (J. Agardh) K.W. Nam	11	S	E			Te	Ez		26344
126. *P. perforata* (Bory) K.W. Nam	1, 2, 3, 6, 7, 8, 9, 15, 18, 19, 22	Ll N S	M, E	Te	Te ♂	Te	Epi/Mg R		20156 20935 21079 24945 24969 26413 26414 26415 26416 26417 26418 26463 26464 26492 26539 26540 26541 26571
127. *Polysiphonia atlantica* Kapraun & J.N. Norris	1, 7	Ll N	M, E	Te	Te		Epi/Mg		19594 23396
128. *P. binneyi* Harvey	1, 7, 13, 18	Ll N S	M, E	Te ♂ Ci	Te	Ci	Epi/Mg R		23230 23397 26345 26542
129. *P. exilis* Harvey	1, 2, 18, 19, 22	Ll N	M	Te Ci	Ci ♂		Epi/Sw R		26346 26347 26348 26349 26543
130. *P. havanensis* Montagne	2, 4, 7, 18	Ll N S	M, E	Te Ci	Te	Te	Epi/Sw		20737 22461 26350 26351
131. *P. scopolorum* Harvey	6	N	E		Ci		Epi/Mg		26352
132. *P. sertularioides* (Grateloup) J. Agardh	6, 7, 13, 22	N S	E		Te	Te	Epi/Mg Epi/Sw		26316 26353 26562 26500
133. *P. subtilissima* Montagne	4, 7, 9, 13, 14	N S	M, E		Te	Te	Epi/Mg Epi/Sw		23263 26356 26357 26358 26526 26544
134. *P. villum* J. Agardh	3, 13	N	E		Te		Epi/Sw		26359 QROO-11-189/07
135. *Vertebrata foetidissima* (Cocks ex Bornet) Díaz-Tapia & Maggs	1, 15, 19	Ll	M	Te Ci			R		21465 24947 25087

Continue...

...Continuation

Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
136. *Wilsonosiphonia howei* (Hollenberg) D. Bustamante, Won & T.O. Cho	1, 2, 3, 10, 11, 13, 14, 15, 19	Ll N S	M, E	Te Ci	♂ Te	Te	Epi/Mg Epi/ Sw Ez R		19844 20314 21078 26360 26361 26363 26364 26365 26366 26367 26368 26540
137. *Wrightiella tumanowiczii* (Gatty ex Harvey) F. Schmitz	1	S	M			Ve	R		26369
138. *Yuzurua poiteaui* (J.V. Lamouroux) Martin-Lescanne	1, 4, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	Ll N S	M, E	Te ♂	Te	Te	Epi/Mg Epi/ Sw R		20587 20936 23748 26362 26370 26419 26420 26421 26422 26465 26466 26493 26494 26545 26572
139. *Y. poiteaui* var. *gemmifera* (Harvey) M.J. Wynne	1, 3, 6, 10, 11, 12, 14, 17, 22	Ll N S	M, E	Te	Te ♂	Te	Epi/Mg Ez R		21535 26371 26372 26373 26374 26423 26495 26496 26573 26574
Wrangeliaceae 140. *Anotrichium tenue* (C. Agardh) Nägeli	1, 3, 4, 7, 8, 11, 12, 13, 14, 21	Ll N S	M, E	Te	Te	Te	Epi/Mg Epi/Th Epi/ Sw R		20561 20832 20997 23332 23660 26376 26377 26378 26379 26380 26546 26563
141. *Griffithsia globulifera* Harvey ex Kützing	18, 19	Ll N	M	Te	Te		Epi/Sw		20114 22841
142. *G. heteromorpha* Kützing	8, 19	Ll	M, E	Te			Epi/Sw		26606 QROO-10-Rh/C
143. *Ptilothamnion speluncarum* (Collins & Hervey) D.L. Ballantine & M.J. Wynne	8	S	E			Te	Epi/Sw		21031
144. *Spermothamnion investiens* (P. Crouan & H. Crouan) Vickers	11	N	E		Te		Epi/Sw		26381
145. *S. repens* (Dillwyn) Magnus	8	S	E			Te	Epi/Mg	**NRMC**	24968
146. *Spongoclonium caribaeum* (Børgesen) M.J. Wynne	1	N	M		Te		Epi/Sw		19834
147. *Wrangelia bicuspidata* Børgesen	1, 3	N S	M		Te	Te	Epi/Sw R		19844 26382
148. *W. penicillata* (C. Agardh) C. Agardh	2, 3	Ll N S	M	Te	Ci	Te	Epi/Sw R		26383 26547 26548
Gelidiales									
Gelidiaceae									
149. *Gelidium pusillum* (Stackhouse) Le Jolis	17	S	E			Te	Ez		23306

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
Gelidiellaceae									
150. *Gelidiella acerosa* (Forsskål) Feldmann & Hamel	1, 2, 3, 15, 19, 22	Ll N S	M	Te	Te	Ve	R		20120 20960 20962 23307 24919 26278 26433 26434 26435 26436 26516
Pterocladiaceae									
151. *Pterocladiella sanctarum* (Feldmann & Hamel) Santelices	6	S	E			Te	Epi/Mg		RhP-10/B1
Gigartinales									
Cystocloniaceae									
152. *Hypnea cervicornis* J. Agardh	11, 15	Ll N	M, E	Te	Te		Epi/Mg Epi/Sw		26254 26503
153. *H. musciformis* (Wulfen) J.V. Lamouroux	2, 8, 11,18	Ll N S	M, E	Te Ci	Te	Te	Epi/Mg Epi/Sw R		20591 23267 23739 26432 26501
154. *H. spinella* (C. Agardh) Kützing	1, 2, 9, 13, 15, 18, 19	Ll N S	M, E	Te	Te	Te	Epi/Mg Epi/Sw R		20352 20457 20464 26255 26431 26502 26586
155. *H. valentiae* (Turner) Montagne	9, 22	Ll S	M	Ve		Te	Epi/Mg Epi/Th Epi/Sw		26256
156. *Hypneocolax stellaris* Børgesen	10	Ll	E	♂			Par		Rh-Par-13
Caulacanthaceae									
157. *Catenella caespitosa* (Withering) L.M. Irvine	7, 10	Ll S	E	Te		Te	Epi/Mg		22436 22439
158. *C. impudica* (Montagne) J. Agardh	4, 6, 7, 8, 9, 10, 11, 12, 14	Ll N S	E	Te	Te Ci	Te	Epi/Mg	NRSK	19780 22437 22438 23295 23296 24891 26426 26388 26426 26427 26428 26429 26505 26506
Rhizophyllidaceae									
159. *Ochtodes maguachaveziae* Mendoza-González, Mateo-Cid & Sentíes	1	S	M			Te Ci ♀♂	R		20661
160. *O. secundiramea* (Montagne) M. Howe	22	S	M			Te	R		20667
Gracilariales									
Gracilariaceae									
161. *Gracilaria blodgettii* Harvey	8	N	E		Te		R		26273
162. *G. cervicornis* (Turner) J. Agardh	1, 2	Ll S	M	Te	Ci		R		26274 26275 26276
163. *G. crassissima* (P. Crouan & H. Crouan) P. Crouan & H. Crouan	1, 22	Ll N	M	Te	Te		R		23308 26270 26271
164. *G. cylindrica* Børgesen	8	N	E		Ve		Ez		26277

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
165. *G. damicornis* J. Agardh	2	Ll S	M	Te		Ve	R		21083 24920
166. *G. tikvahiae* McLachlan	10	Ll	E	Te			R		19953
Peyssonneliales									
Peyssonneliaceae									
167. *Agissea simulans* (Weber Bosse) Pestana, Lyra, Cassano & J.M.C. Nunes	1, 2, 8, 19	Ll N S	M, E	Te Ci	Te	Ve	Epi/Sw Ez		20186 20471 26593 26594 26595
168. *Metapeyssonnelia milleporoides* D.L. Ballantine & H. Ruiz	1	N	M		Te		Ez	**NRMC**	26238 26598
169. *M. tangerina* D.L. Ballantine, C. Lozada-Troche & H. Ruiz	1, 22	N	M		Te		R Ez	**NRMC**	21316 26197
170. *Peyssonnelia armorica* (P. Crouan & H. Crouan) Weber Bosse	3, 8	N S	M, E		Te	Te	Epi/Sw Ez		20180 26487 26596
Rhodymeniales									
Champiaceae									
171. *Champia parvula* (C. Agardh) Harvey	1, 3, 8	Ll N S	M, E	Ci Te	Te	Po♀	Epi/Th Epi/Mg Epi/Sw		19840 20965 20997 24895 26389 26390 26514
172. *Champia parvula* var. *prostrata* L.G. Williams	7, 8, 12	Ll N	E	Te	Te		Epi/Th		24896 26252
173. *C. salicornioides* Harvey	3	N	M		Te		Epi/Th		26253
174. *Coelothrix irregularis* (Harvey) Børgesen	1, 6, 14, 19, 22	Ll N	M, E	Ve	Te		Epi/Mg R		20119 23266 24897 26391 26392
Halymeniaceae									
175. *Cryptonemia crenulata* (J. Agardh) J. Agardh	1, 2	Ll N	M	Te	Te		Ez		26279 26280
176. *Phyllymenia gibbesii* (Harvey) Showe M. Lin, Rodríguez-Prieto, De Clerck & Guiry	5	S	E			Te	Pe		20226
Lomentariaceae									
177. *Ceratodictyon intricatum* (C. Agardh) R.E. Norris	1	S	M			Ve	R		26293
Compsopogonophyceae									
Erythropeltales									
Erythrotrichiaceae									
178. *Erythrocladia irregularis* Rosenvinge	1, 3, 9, 16, 18, 21	Ll N S	M	Ve	Ve	Ve	Epi/Sw		20763 24954 26267 26322 26347 26402 26487 26532
179. *Erythrotrichia carnea* (Dillwyn) J. Agardh	1, 2, 3, 4, 7, 8, 9, 13, 15, 16, 17, 18, 20, 22	Ll N S	M, E	Ve	Ve	Ve	Epi/Sw		20732 20737 20866 20887 23302 24954 26267 26306 26317 26318 26347 26366 26385 26483 26500 26546 26541 26561 26605 26608

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Division/species	Localities	Seasonality	Environment	Reproduction			Habitat	Obs	ENCB Herbarium voucher number
				Rains	Winter rains (northern)	Dry			
180. *Sahlingia subintegra* (Rosenvinge) Kornmann	2, 11, 13, 14, 17, 18	Ll N S	M, E	Ve	Ve	Ve	Epi/Sw		24954 26237 26385 26528 26532 26565 2661017,
Stylonematophyceae									24954 26242
Stylonematales									26292 26338
Stylonemataceae									26377 26562
181. *Chroodactylon ornatum* (C. Agardh) Basson	6, 11, 13, 16, 22	N S	M, E		Ve	Ve	Epi/Sw		
182. *Stylonema alsidii* (Zanardini) K.M. Drew	1, 2, 6, 8, 11, 14, 16 18, 22	Ll N S	M, E	Ve	Ve	Ve	Epi/Sw		19958 20737 20864 20933 20936 26240 26302 26312 26377 26523 26527 26528 26568

SIMBOLS: Localities: 1. Punta Pelícanos, 2. Hualapich, 3. Punta Xoquem; 4. El Playón, 5. Punta Allen, 6. Punta Gorda, 7. Vigía Chico, 8. Cayo y Punta Valencia, 9. Hualastok, 10. Río Temporal, 11. Cayo Cedro, 12. Cayo Lagartijas, 13. Cayo Tres Marías, 14. Cayo Xobón, 15. Punta Tupac, 16. Isla Techal, 17. Golfito, 18. Punta Herrero, 19. El Faro, 20. Punta Mosquitero, 21. Playa Dei, 22. Pulticub. Seasonality: Ll = rains (September, 2009, June 2010, August and September 2012), N = Winter rains (northern) (January 2011, December 2011); S = Dry (March, 2009, April, 2010, 2012, 2015). Environment: M = marine, E = estuarine. Reproduction: Ve = vegetative, Mn = Monosporangio, Po = Poliesporangia, Te = Tetrasporangia, Ci = Carpoporophyte, ♀ = Carpogonia, ♂ = spermatie. Habitat: Epi/Sw = epiphyte on other macroalgae, Epi/Th = epiphyte on *Thalassia testudinum*, Epi/Mg = epiphyte on mangrove roots, Ez = Epizoic, Ro = Rodolithes, R = Rocky, Par = Parasite. Obs (Observations): NRSK = New record of RBSK, NRMC = New record of Mexican Caribbean.

Table 3. Species not located in the study period (Reported by Valadez-Cruz et al., 2014, García-García et al. 2020).

Species	Observations
Florideophyceae	
Corallinales	
Corallinaceae	
1. *Jania pumila* J.V. Lamouroux	RD
2. *Jania subulata* (Ellis & Solander) Sonder	
3. *Jania tenella* (Kützing) Grunow	RD
Mesophyllumaceae	
4. *Mesophyllum incertum* (Foslie) Me.Lemoine	
Spongitidaceae	
5. *Neogoniolithon trichotomum* (Heydrich) Setchell & L.R. Mason	RD
Orden Nemaliales	
Galaxauraceae	
6. *Tricleocarpa fragilis* (L.) Huisman & Townsend	
Ceramiales	
Callithamniaceae	
7. *Aglaothamnion cordatum* (Børgesen) Feldmann-Mazoyer	
8. *Aglaothamnion halliae* (Collins) Aponte, D.L. Ballantine & J.N. Norris	
9. *Crouania pleonospora* W.R. Taylor	
Ceramiaceae	
10. *Centroceras clavulatum* (C. Agardh) Montagne	RD
11. *Ceramium cimbricum* H.E. Petersen	
12. *Ceramium cimbricum* f.*flaccidum* (H.E. Petersen) G. Furnari & Serio	
13. *Ceramium subtile* J. Agardh	

Continue...

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14. *Ceramium virgatum* Roth	
Delesseriaceae	
15. *Dasya mollis* Harvey	
16. *Martensia fragilis* Harvey	
Rhodomelaceae	
17. *Amansia multifida* J.V. Lamouroux	
18. *Carradoriella denudate* (Dillwyn) Savoie & G.W. Saunders	
19. *Chondria curvilineata* Collins & Hervey	
20. *Chondria platyramea* Joly & Ugadim	
21. *Digenea simplex* (Wulfen) C. Agardh	RD
22. *Laurencia minuta* Vandermeulen, Garbary & Guiry	
23. *Melanothamnus harveyi* (Bailey) Díaz-Tapia & Maggs	
24. *Melanothamnus hawaiiensis* (Hollenberg) Díaz-Tapia & Maggs	RD
25. *Melanothamnus pseudovillum* (Hollenberg) Díaz-Tapia & Maggs	
26. *Melanothamnus tongatensis* (Harvey ex Kützing) Díaz-Tapia & Maggs	RD
27. *Polysiphonia breviarticulata* (C. Agardh) Zanardini	
28. *Polysiphonia opaca* (C. Agardh) Moris & De Notaris	
29. *Wrightiella blodgettii* (Harvey) F. Schmitz	
Wrangeliaceae	
30. *Grallatoria reptans* M. Howe	

Continue...

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31. *Griffithsia heteromorpha* Kützing
32. *G. radicans* Kützing
33. *Haloplegma duperreyi* Montagne
34. *Spermathamnion gymnocarpum* M. Howe
35. *Tiffaniella gorgonea* (Montagne) Doty & Meñez
36. *Wrangelia argus* (Montagne) Montagne
Gigartinales
Gigartinaceae
37. *Chondracanthus acicularis* (Roth) Fredericq
38. *C. teedei* (Mertens ex Roth) Kützing
Kallymeniaceae
39. *Kallymenia limminghei* Montagne
Solieriaceae
40. *Eucheumatopsis isiformis* (C. Agardh) Núñez-Resendiz, Dreckmann & Sentíes
41. *Wurdemannia miniata* (Sprengel) Feldmann & Hamel
Gracilariales
Gracilariaceae
42. *Gracilaria armata* (C. Agardh) Greville
43. *Gracilaria cornea* J. Agardh
44. *Gracilaria debilis* (Forsskål) Børgesen
Peyssonneliales
Peyssonneliaceae
45. *Peyssonnelia conchicola* Piccone & Grunow
Halymeniales
Halymeniaceae
46. *Corynomorpha clavata* (Harvey) J. Agardh
47. *Halymenia duchassaingii* (J. Agardh) Kylin
Nemastomatales
Schizymeniaceae
48. *Platoma cyclocolpum* (Montagne) F. Schmitz
Rhodymeniales
Champiaceae
49. *Gastroclonium parvum* (Hollenberg) C.F. Chang & B.M. Xia
Rhodymeniaceae
50. *Botryocladia pyriformis* (Børgesen) Kylin
51. *Chrysymenia planifrons* (Melvill) J. Agardh

RD = Uncertain record.

and they were found both in the sporophytic phase (sporophyte and carposporophyte) and in the gametophytic phase (Table 2).

5. Epiphytism

Altogether 119 epiphytic taxa were identified (Table 2), by host we have that, from them, 54 grew exclusively on other Rhodophyta, 29 lived on the roots or bark of mangrove (*Rhizophora mangle* Linnaeus), 8 in *Thalassia testudinum* Banks ex König, 12 both in mangrove as in other Rhodophyta, 7 in other Rhodophyta and *Thalassia,* only 3 were inhabitants of both *T. testudinum* and mangrove roots and finally 6 taxa were located in all hosts (Figure 5). The highest number of epiphytes was obtained in the dry season with 92, observing the highest number of species of the families Rhodomelaceae, Wrangeliaceae and Ceramiaceae.

Discussion

1. Floristics

The total number of taxa found in this study is greater than that recorded on the coast of the island of Cozumel Mateo-Cid & Mendoza-González (1991) cited 168 Rhodophyta taxa; Mateo-Cid & Mendoza-González (1992) recorded 122 red algae off the coast of Isla Mujeres; Dreckmann et al. (1996) recorded 109 Rhodophyta in Puerto Morelos. On the other hand, Cetz-Navarro et al. (2008) listed 53 Rhodophyta taxa for Quintana Roo in works after the catalog by Ortega et al. (2001). In the case of Valadez-Cruz et al. (2014) these authors documented 172 Rhodophyta taxa for the Sian Ka'an Biosphere Reserve, which shows that the RBSK has a great specific richness of red algae from the Quintana Roo coast, with numerous taxa characteristic of the region. In addition, the results obtained suggest that the RBSK is an area with high floristic diversity, if one considers that 50.4% of the Rhodophyta known for the coast of Quintana Roo can be found on its coastline, which is 451 species and 13 infraspecific categories of red algae (García-García et al. 2020).

The best represented family in our study was Rhodomelaceae with 65 taxa, a figure greater than that found by Mateo-Cid & Mendoza-González (1991) where the authors recorded 38 Rhodomelaceae taxa for Cozumel Island, Dreckmann et al. (1996) cite 34 for Puerto Morelos and Senties & Dreckmann (2014) recorded 26 species of the Rhodomelaceae family for the coast of Campeche. On the other hand, Senties & Dreckmann (1990) indicate that the Rhodomelaceae family (order Ceramiales) is the most numerous not only within the Order, but also within the Rhodophyta division. The species of this order have a greater affinity for tropical, subtropical, and temperate zones, occupying mostly rocky substrates and some epiphytes in intertidal and subtidal environments, characteristics that our study locations present. The specific richness and the presence of the species of the order Ceramiales in all the localities of the RBSK can be explained in several ways; one of them is that red algal order Ceramiales contains the 37.6% of all floridean red algal species (Guiry & Guiry 2023). It is a highly diverse group in terms of number of species, with over 330 genera and over 2690 species. The order is represented in all marine and brackish habitats worldwide and is comprised of five families: Callithamniaceae, Ceramiaceae, Delesseriaceae, Rhodomelaceae and Wrangeliaceae (Guiry & Guiry 2023). In addition to their high diversity, the Ceramiales have a great adaptability to develop in different environments. For example, the Rhodomelaceae species occupy various marine habitats: they can grow as free-living plants on stones, rocks, shells, and different artificial substrata, or colonize other algae either as obligate epiphytes or as parasites. Also, there are cosmopolitan species growing within a broad range of temperature (0–28 °C), salinity (6.0–32.5‰), and vertical distribution. In different locations it may occur in the low-intertidal zone, in rock pools, in shallow or deep (15–17 m) subtidal water along open, wave-exposed coasts and in sheltered habitats (Tarakhovskaya et al. 2022). On the other hand, many studies show that the species of the order Ceramiales are successful, due to their asexual reproduction and the vegetative multiplication mechanisms as fragmentation, multicellular propagules, and monopodial stoloniferous growth (Kilar & McLachlan 1986, Kapraun 1977, Haroun & Gil-Rodriguez 1995, Husa & Sjøtun 2006, Cecere et al. 2007).

 https://doi.org/10.1590/1676-0611-BN-2023-1572

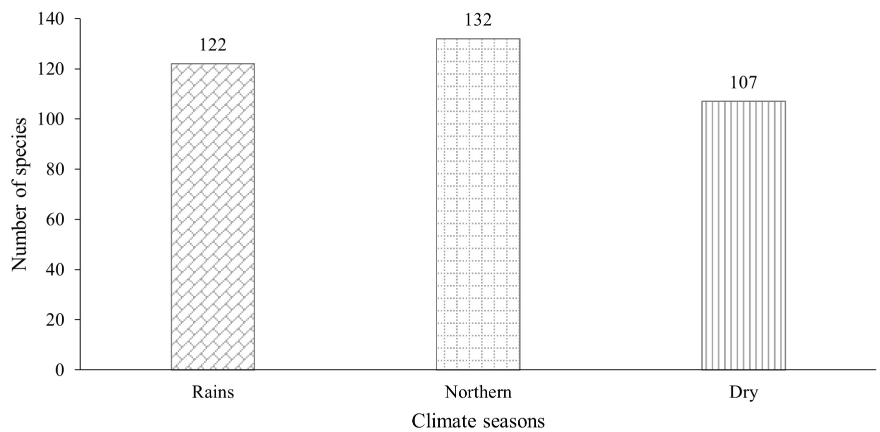

Figure 2. Number of taxa by climatic season.

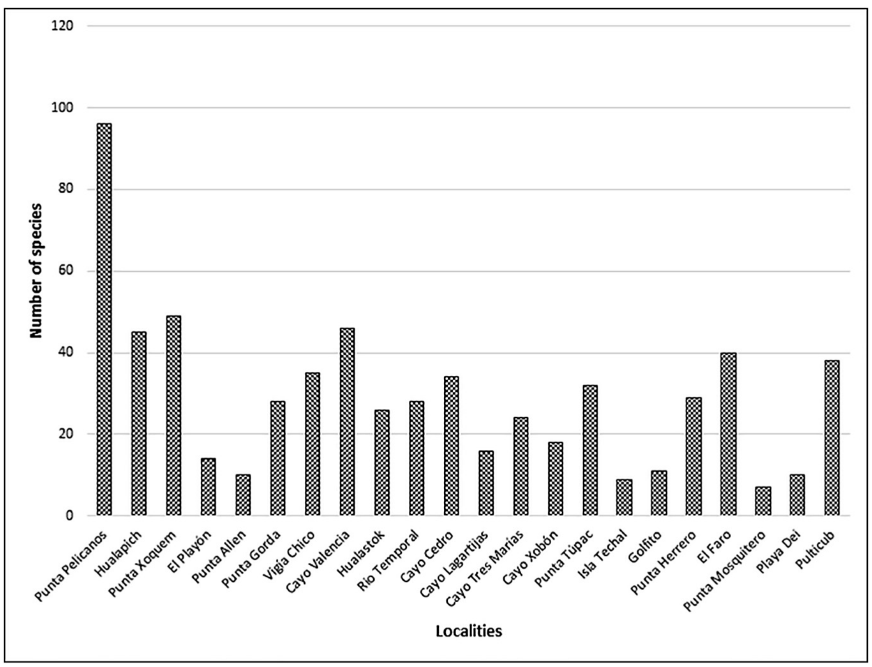

Figure 3. Number of taxa per locality.

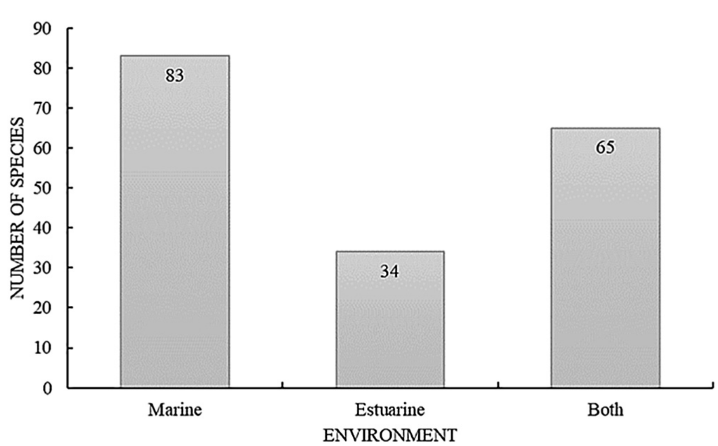

Figure 4. Number of taxa by environment.

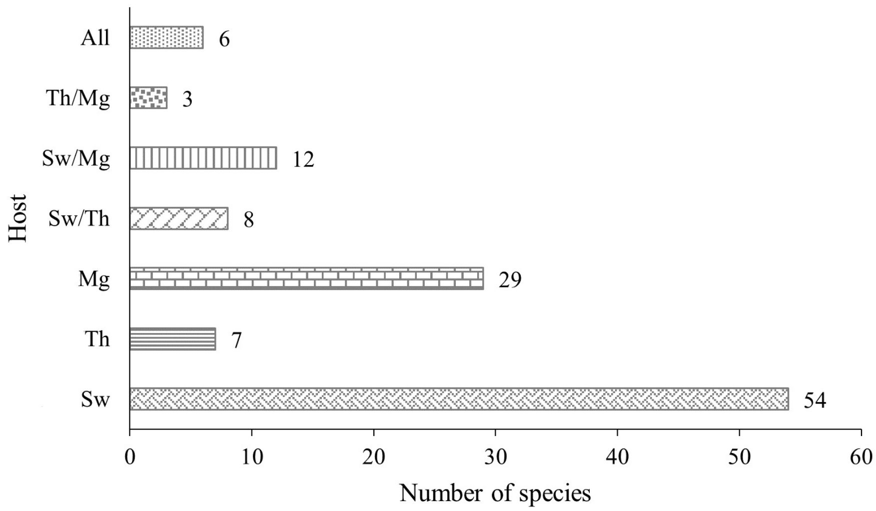

Figure 5. Number of epiphytes by host (abbreviations = Mg = *Rhizophora mangle*, Th = *Thalassia testudinum*, Sw = Other macroalgae).

Table 4. Feldmann and Cheney indices for some marine environments of the coast of the Gulf of Mexico and the Mexican Caribbean.

Locality/state	Feldmann index (R/P)	Cheney index (R + C)/P
Mujeres island, Quintana Roo	4.50	7.15
Cozumel island, Quintana Roo	4.40	7.04
Puerto Morelos, Quintana Roo	3.40	5.60
Yucatán coast	6.00	9.00
Campeche coast	5.37	9.30
Sian Ka'an Biosphere Reserve (This study)	**4.68**	**7.26**

Of the 182 taxa determined in this study for the RBSK coastline, 25 represent new records for the study area (NRSK) and of these, 8 are new records for the Mexican Caribbean (Table 2); on the other hand, 51 previously recorded species were not located (Table 3), perhaps due to changes in the environments where these algae inhabit, where there is currently a greater human influence that has modified the architecture of the landscape, as well as natural events such as hurricanes and Tropical storms. Entirety, previous records, and those obtained in this study constitute a total of 233 registered species for the RBSK, however, it is important to highlight that the Espiritu Santo Bay has not been sufficiently studied, so to know the phycofloristic composition throughout the reserve, more studies are required in this bay.

There are also doubtful records of some species, to name a few, Won et al. (2009) in their work on the morphological and molecular characterization of the genus *Centroceras*, found that samples identified under the concept of "*Centroceras clavulatum*" represented 9 morphological groups that corresponded to different clades in their phylogenetic analysis and determined that the distribution of *C. clavulatum* is restricted to northern Chile, Peru, southern California, southern Australia and New Zealand, which makes its presence in the Mexican Caribbean region unlikely. Díaz-Tapia et al. (2017) sought to clarify the relationships in the *Neosiphonia/Polysiphonia* complex using a combination of molecular and morphological analyses, based on their results they transferred 46 species of *Neosiphonia* to *Melanothamnus*, including *Melanothamnus hawaiiensis* (type locality: Waikiki, Oahu, Hawaiian Islands) also indicating, the distribution of the genus *Melanothamnus* is predominantly in the Indo-Pacific, so it is necessary to reevaluate the species of the genus *Melanothamnus* that have been cited in the Mexican Caribbean.

Particularly for the genus *Jania*, it is widely known about its complicated scenario to establish limits between species due to the substantial morphological variation that it exhibits, consequently, the correct application of names for many species of *Jania* is surrounded by uncertainty and, therefore, lacks knowledge of a stable nomenclatural foundation, and descriptions are often brief and inadequate as well (Harvey et al. 2020). Harvey et al. (2020) in a study of the genus *Jania* in Australia evaluated 79 diagnostic characters to delimit the species of this genus, finding that many of these characters' overlap each other or are inadequately explained, some characters or character states were not found in species from south-eastern Australia or its nomenclatural types and therefore could not be assessed. Others were present in all specimens and thus were of no value in delineating species found in south-eastern Australia and which records of some species from south-eastern Australia involve misidentified specimens. In their study, Harvey et al. (2020) transferred *J. adhaerens* as a synonym of *Jania pedunculata* var. *adhaerens*, indicating that, in the published literature, the concept of the morphoanatomy of *J. adhaerens* varies considerably from publication to publication. In addition, there is no consensus in the literature regarding what defines *J. adhaerens* as a species from a morphoanatomical point of view, so it is necessary to review the type of material and molecular sequence data may also be useful. Finally, the authors excluded *J. rubens* from south-eastern Australia because the records are based on misidentifications. The type locality of *J. rubens* is 'Insulae Stoechades' [Îles d' Hyères, Francia, Mediterráneo], in the prologue Linnaeus (1758, p. 806) indicated 'Habitat en Oceano Europæo' and it is not known whether this includes the Mediterranean (Guiry & Guiry 2023). Regarding *J. tenella*, the type locality is the Gulf of Naples (Italy), and the distribution of this species is mainly in the Pacific islands, Japan, and

Taiwan (Guiry & Guiry 2023). It is evident that the *Jania* species cited in the Mexican Caribbean require morphological and molecular studies to find the true taxonomic and phylogenetic affinities of these species, as well as to delimit their distribution in the study area.

The use of morphoanatomical characters in the determination of non-geniculate coralline algae collected in the RBSK has been problematic; this fact is consistent with what was reported by Kato et al. (2013), Mateo-Cid et al. (2014) and Richards et al. (2021), due to the above and based on sequencing only 20 specimens from the rather narrow study area, we have recovered 9 species of *Neogoniolithon*, and 2 *Harveylithon* and *Porolithon* each, in the case of *Spongites* and *Lithothamnion* specimens lack many morphoanatomical characters needed to adequately describe them, particularly those characters associated with reproduction. We have not sequenced any specimens that morphoanatomical we call *S. fruticulosus* and *L. sejunctum*. We recognize that acceptance of each of these names for our local species will depend upon sequencing some specimens.

2. *Biogeography*

The results of the present study were examined with the Feldmann and Cheney indices and were contrasted with what was found by Mateo-Cid & Mendoza-González (2007) for Isla Cozumel; Mendoza-González et al. (2007) from Isla Mujeres, Dreckmann et al. (1996) for Puerto Morelos and Huerta-Múzquiz et al. (1987), Ortegón-Aznar et al. (2001, 2009) and Sánchez-Molina et al. (2007) for the Yucatan coast. Table 4 shows the data obtained from the Feldmann and Cheney indices calculated in the four regions mentioned; the phycoflora of the study area is similar to that obtained for the Isla Cozumel and Isla Mujeres, completely Caribbean localities. The indices used allow us to establish that the marine and estuarine algae of the Sian Ka'an Biosphere Reserve have a predominant tropical distribution and that, accordingly, the presence of *Jania cubensis, Amphiroa fragilissima, A. tribulus*, *Neogoniolithon spectabile*, *Titanophycus validus, Ceramium nitens, Dasya caraibica, Bostrychia binderi, Chondria littoralis, Wrangelia penicillata, Gracilaria blodgettii* and *G. crassissima*, were recorded among others.

3. *Temporal variation*

In the present work, the highest species richness was found in the northern (winter rains), followed by summer rains, and the lowest species richness was found in the dry season. This can be justified with what is reported by Pech-Poll et al. (2010) who relate the physicochemical parameters with the abundance and diversity of species, in addition to the amount of nutrients available in the habitat, in the case of the summer or winter rainy season, the supply of nutrients is greater due to runoff along the coast, this would also justify the fact that a high species richness is present in the northern rainy climatic season, not varying in great number with the rainy season. On the other hand, the dry climatic season provides a more adverse habitat due to the low rainfall that exists in the season, as well as the high temperature that occurs, since it can reach more than 30 °C, which increases the evaporation of seawater and therefore salinity. Mateo-Cid & Mendoza-González (1991) mention that seasonality in the Mexican Caribbean is related to large temperature fluctuations throughout the year.

The changes in each community at each time of the year are largely regulated by the biological rhythms of the organisms that constitute it, which in turn are related to environmental fluctuations (Núñez-López 1996), which modify the physicochemical characteristics of seawater associated with the seasonality of the environment. The spatial and temporal variability is affected by factors such as the complexity of the substrate, as well as temperature and salinity, since at high atmospheric temperature water evaporation is greater, generating hot water and higher salinity, on the contrary, when there is a high rate of rainfall, a considerable discharge of fresh water is caused along the coast (Pech-Poll et al. 2010).

In this context, Punta Pelicanos, Hualapich, Punta Xoquem and Pulticub provide adequate conditions for the high specific richness of red algae that are present, this is because in the intertidal zone there are platforms and rocky plains with gentle waves, in addition these beaches are in a conserved region for being within the reserve. In the same way, the localities where there was a low specific richness correspond to Cayo Lagartijas, Cayo Xobón, Punta Allen, Isla Techal and Golfito, localities that are located within the bays, purely estuarine areas, in which there are no adequate conditions for the establishment and development of the Rhodophyta, especially the type of substrate that is mostly sandy and the presence of seagrass beds and mangroves. It is important to highlight that a high percentage of the Rhodophyta species of the Mexican Caribbean have been collected in rocky substrate, Santelices (1977), Mateo-Cid & Mendoza-González (1991), Mendoza-González & Mateo-Cid (1992) and Ortega et al. (2001) indicate that this substrate exposed to waves is the place where a great diversity of marine algae is located.

4. *Reproduction*

The reproductive stage best represented in this study was the sporic stage, which coincides with the results obtained by Mateo-Cid & Mendoza-González (1991), Mendoza-González & Mateo-Cid (1992), Mateo-Cid et al. (2013), and Lucio & Nunes (2002), the latter authors mention that the dominance of a reproductive phase may be influenced by temporary changes in local environmental factors. On the other hand, Ardito & Gómez (2005) consider that the sporophytic generation has a longer survival than the gametophytic generation, in addition to other reproductive mechanisms such as vegetative propagation or apomeiosis.

The sexual stages were poorly represented in this study, according to Santelices (1977) asexual reproduction has the advantage of requiring less energy expenditure for the formation of spores and their rapid dissemination, compared to the formation of sperm and carpogonium that give rise to the carposporophytic phase, which are only present when environmental conditions become adverse.

5. *Epiphytism*

The highest number of epiphytes was obtained in the dry season with 92, observing the highest number of species from the Rhodomelaceae, Wrangeliaceae and Ceramiaceae families with 11 each, most of these species are filamentous, small, and annual. Most of the epiphytes were found growing frequently on other larger Rhodophyta such as *Gracilaria*, *Laurencia*, *Palisada*, *Acanthophora*, *Alsidium*, and *Digenea*. It has been suggested that host longevity must be long enough to allow these organisms to complete their life cycle and that this could be a reason for the absence of epiphytes in algae with short and ephemeral lifecycles (Santelices 1977). Regarding the rainy season, 87 species were identified, a number very close to that found in the dry season. In this season it was observed that fleshy corticated macroalgae grew both on rocky substrates and epiphytes of other macroalgae, which can be attributed to the fact that the populations of both epilithic and epiphytic benthic marine algae are growing. On the other hand, it is necessary to consider that in the RBSK there are seagrass meadows and mangroves, both populations of vascular plants offer an adequate substrate for the fixation and growth of epiphytic algae (Nava-Olvera et al. 2017, Peña-Salamanca 2017).

Seagrass meadows *Thalassia testudinum* represent a coastal ecosystem of great value in the RBSK, mainly due to the ecosystem services they offer, the vertical and horizontal structure of the seagrass plants favours the appearance of many microhabitats, transforming the leaves into an ideal substrate for the development of many epiphytic organisms (Díaz-Merlano et al. 2003, Nava-Olvera et al. 2017). Nava-Olvera et al. (2017) in their study of epiphytic algae in Veracruz and Quintana Roo, determined 46 epiphytic algae taxa on *T. testudinum* in Santa Rosa, Quintana Roo, 38 of them correspond to Rhodophyta, which highlights its high contribution quantitatively compared to other groups of algae. This dominance is consistent with previous records in other regions, where red algae have been documented to dominate in species composition and biomass (Mendoza-González & Mateo-Cid 1992, Quan-Young et al. 2006). Records of Rhodophyta in studies of epiphytic floras, both in marine angiosperms (Ibarra-Obando & Aguilar-Rosas 1985, Barrios & Díaz 2005), and in macroalgae (Montañés et al. 2003, Quan-Young et al. 2006, Ortuño-Aguirre & Riosmena-Rodríguez 2007), point out that red algae are the group with the greatest specific richness within epiphytism, since they present life forms and reproductive strategies that allow them to remain longer in the phorophyte (Albis-Salas 2010). Regarding mangroves, the roots and remains of these trees constitute a firm and safe substrate for the organisms that inhabit them; regarding epibiont algae and invertebrate communities, the roots provide a large moist surface available for colonization. It has been proven that the tolerance of mangrove algae to variations in salinity and periods of desiccation is due to their ability to synthesize, accumulate and regulate organic compounds that protect them from unfavourable factors for them (Ríos et al. 2019).

In our study, a total of 29 exclusive epiphytic species were located in mangrove roots and bark, mainly from the genus *Bostrychia* with 6 species, *Caloglossa* and *Murrayella* with one species each and *Catenella* 2. These results agree with what was recorded by other authors such as Peña-Salamanca (2017) and Ríos et al. (2019) who mention that the association of the Bostrychietum complex is well known, which is a group of algae associated with mangrove roots in tropical and subtropical areas, composed mainly of the genera *Bostrychia, Caloglossa, Catenella,* and *Murrayella*, as well as other genera. Epiphytes that were also found in the mangrove roots were *Polysiphonia* and *Dasya* with 5 taxa each and *Chondria* with 3, most of the species that make up the Bostrychietum algal complex such as the genera *Polysiphonia, Dasya* and *Chondria* they belong to the order Ceramiales which has the highest specific richness within Rhodophyta and its species have a wide worldwide distribution (Guiry & Guiry 2023).

Conclusion

The analysis and integration of previous studies of Rhodophyta in the study area and the results obtained confirm the importance of carrying out phycofloristic inventories in little-worked coastal regions of the RBSK, which will result in a better understanding of the diversity of this important cluster. These results are the basis for future ecological, sustainable management and conservation studies, so it is recommended to continue with the sampling in the localities visited to observe the spatial and temporal changes of the flora that allow identifying possible alterations in the environmental conditions of the area of the RBSK.

Acknowledgments

We thank to the Instituto Politécnico Nacional for providing financial assistance, facilities, and equipment necessary for the development of this research. The Comisión de Operación y Fomento de Actividades Académicas del I.P.N. and EDI/IPN have provided fellowships to ACMG and LEMC. The authors wish to thank to Dirección General de Ordenamiento Pesquero y Acuícola de México for permission to collect in the restricted waters of the Biosphere Reserve of Sian Ka’an (No. DGOPA 08980.011111.3063).

Associate Editor

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Conflicts of Interest

The author(s) declare(s) that they have no conflict of interest related to the publication of this manuscript.

Ethics

This study did not involve human beings and/or clinical trials that should be approved by one Institutional Committee.

Data Availability

Persistent identifier https://doi.org/10.15468/v7avng

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Received: 09/03/2023
Accepted: 24/03/2024
Published online: 29/04/2024