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Marine benthic macroalgae from Manguinhos beach, Itaparica, Bahia, Brazil

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Abstract: The State of Bahia has the longest coastline in Brazil (1,103 km), characterized by oligotrophic waters and a wide variety of substrates occurring in diverse coastal environments, such as sandy beaches, organogenic reefs, sandstone formations, rocky shores, and mangroves. These features favor the richness and diversity of marine macroalgae in the region. This study presents the first floristic inventory of benthic marine macroalgae from Manguinhos Beach, located in the municipality of Itaparica, contributing to the knowledge of marine macroalgal biodiversity in the State of Bahia. Sampling was conducted during low spring tides between September 2014 and April 2017, totaling 18 collections. A total of 85 infrageneric taxa were identified, comprising 46 Rhodophyta, 18 Ochrophyta, and 21 Chlorophyta, distributed across 18 orders, 33 families, and 56 genera. Rhodophyta represented the highest proportion of taxa (54.12%) compared with Ochrophyta (21.17%) and Chlorophyta (24.71%), corroborating the pattern that red algae are the most abundant group in tropical regions, as also observed in the subtropical and tropical western Atlantic. Nevertheless, further floristic surveys at additional beaches are imperative to encompass other areas of Itaparica Island, as well as other island systems in the state, many of which still represent significant gaps in the study of algal biodiversity.

Keywords: Algae, Tropical Island, Northeast Brazil.

Macroalgas bentônicas marinhas da praia de Manguinhos, Itaparica, Bahia, Brasil

Resumo: O Estado da Bahia possui o maior litoral do Brasil, 1.103 km, águas oligotróficas e uma ampla gama de substratos, localizados em uma variedade de ambientes costeiros: praias arenosas, recifes organogênicos, formações areníticas, costões rochosos e manguezais, favorecendo a riqueza e diversidade de macroalgas marinhas nesta região. Este trabalho apresenta o primeiro inventário florístico de macroalgas marinhas bentônicas na praia de Manguinhos (município de Itaparica), contribuindo para o conhecimento da biodiversidade de macroalgas marinhas no Estado da Bahia. As amostragens foram realizadas durante as marés baixas de sizígia entre os meses de setembro de 2014 e abril de 2017, totalizando 18 coletas. Oitenta e cinco táxons infragenéricos foram identificados, totalizando 46 Rhodophyta, 18 Ochrophyta e 21 Chlorophyta, distribuídos em 18 ordens, 33 famílias e 56 gêneros. Foi identificada uma maior porcentagem de Rhodophyta (54%) em comparação aos demais filos (21,2% Ochrophyta e 24,7% Chlorophyta), corroborando a informação de que as Rhodophyta são as mais abundantes em regiões tropicais, seguindo um padrão que pode ser observado no Atlântico Ocidental tropical e subtropical. No entanto, é imprescindível a realização de novas amostragens florísticas em outras praias, a fim de abranger outras regiões da Ilha de Itaparica, bem como outras regiões insulares do estado, muitas das quais ainda representam lacunas no estudo da biodiversidade.

Palavras chave: Alga, Ilha tropical, Nordeste do Brasil.

Introduction

The State of Bahia has the longest coastline in Brazil, 1.103 km (Bahia, 1999), characterized by oligotrophic waters (Horta et al., 2008) and a wide variety of substrates (Nunes, 1998) occurring in diverse coastal environments, such as sandy beaches, organogenic reefs, sandstone formations, rocky shores, and mangroves (Leão, 1996, Leão, Kikuchi & Testa, 2003), which favor the high richness and diversity of marine macroalgae in this region.

The benthic marine flora on the coast of Bahia is relatively well known, currently comprising 473 species of macroalgae, of which 60 are Ochrophyta, 132 Chlorophyta and 284 Rhodophyta (Flora e Funga do Brasil), result of studies carried out in the last three decades (Altamirano; Nunes, 1997, Nunes, 1997, 1998, Nunes et al., 1999, Nunes; Paula, 2000, 2001, 2004, 2006, Lucio, Nunes, 2002, Marins et al., 2008, Almeida et al., 2012, Costa et al., 2012, Caires et al., 2013, Jesus, Schnadelbach Nunes, 2013a, Santos, Nunes, 2014, 2015a, 2015b, Lyra et al., 2015, 2016, Moura et al., 2015, Cassano et al., 2019, Pestana et al., 2020 & Santos et al., 2013, 2020, 2022).

Despite its well-known benthic marine flora, the State of Bahia remains a priority region for floristic surveys, given the large number of new records and recently described species (Jesus, Guimarães, Nunes, 2013, Jesus et al., 2016, 2019, Lyra et al., 2016, Costa et al., 2019, Pestana et al., 2020 & Santos et al., 2020, 2022). In addition, due to its vast extension and diverse geographic conditions, many regions of the state have yet to be studied.

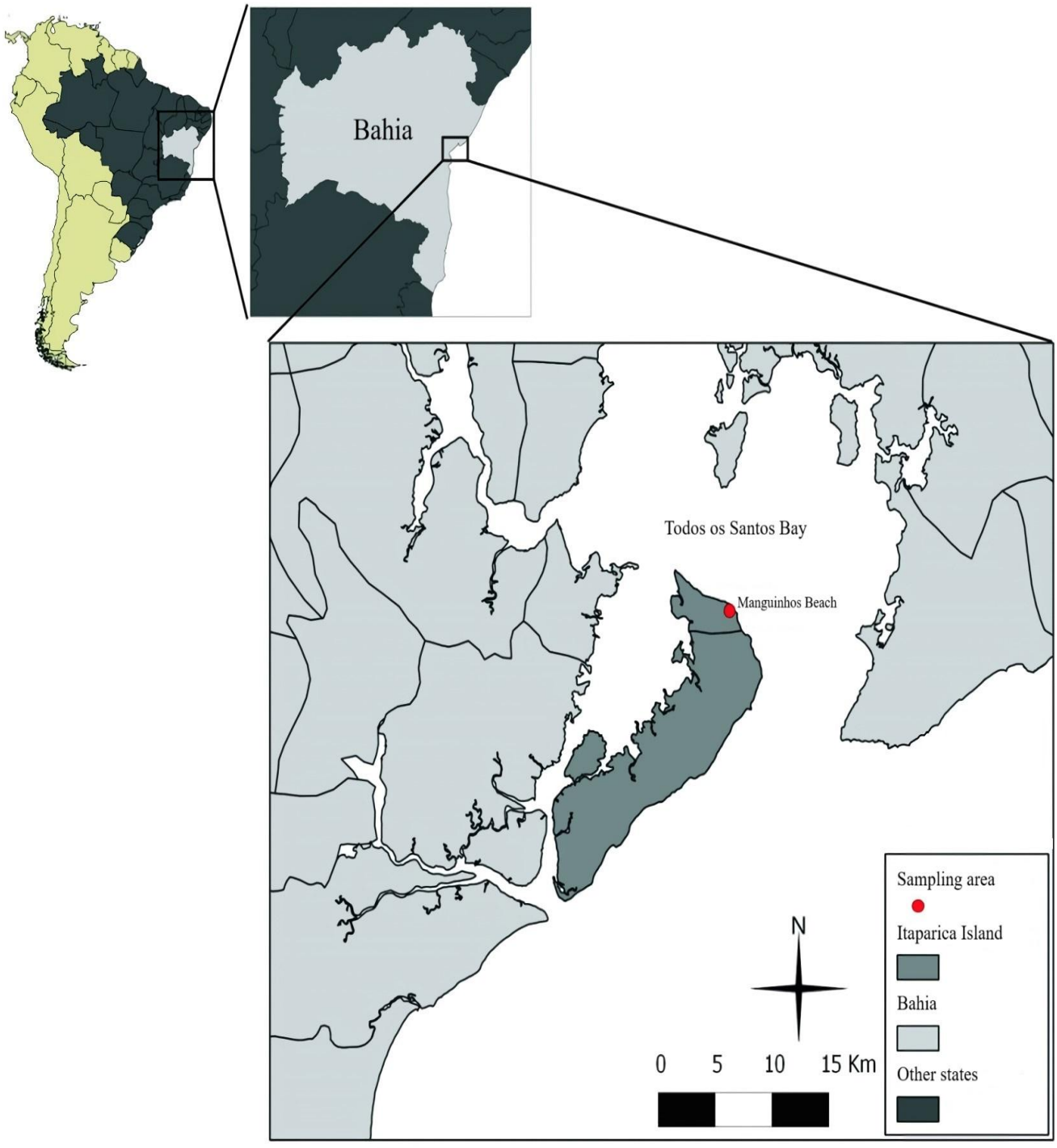
Although it has easy accessibility by waterway and highway, being part of the Metropolitan Region of Salvador, the Island of Itaparica, which comprises the municipalities of Itaparica and Vera Cruz, lacks floristic studies, since many taxonomic works published with sampling on the island are concentrated on some beaches, such as Penha beach (Amorim, Moura, Moniz-Brito, 2006, Santos, Nunes, 2014, 2015a & Lyra et al., 2016). Considering the island's 40 km long coastline, many beaches remain as gaps for floristic studies in Bahia, as Praia de Manguinhos, located in the municipality of Itaparica.

This study presents the first floristic inventory of benthic marine macroalgae from Manguinhos Beach, located in the municipality of Itaparica, contributing to the understanding of marine macroalgal biodiversity in the State of Bahia and, consequently, along the Brazilian coast.

Material and methods

The present study was conducted at Manguinhos Beach (12°54'29"S, 38°38'9"W), in the municipality of Itaparica, Itaparica Island, State of Bahia, Brazil (Figure 1). The beach extends for approximately 7.39 km, representing 0.67% of the coastline of the State of Bahia. Sampling was performed during low spring tides, according to the Tide Tables of the Brazilian Navy's Hydrography and Navigation Directorate (DHN), between September 2014 and April 2017, totaling 18 collections. The collection, sample packaging, processing, and identification of the algal material followed the methodology described by Nunes (2010). The taxonomic arrangement follows Guiry e Guiry (2025). All specimens studied were fixed in 4% formalin and are deposited in the Herbarium of the Biology Sector, Federal University of Recôncavo da Bahia (HURB).

Figure 1 - Map showing the location of Manguinhos Beach, municipality of Itaparica, Bahia, Brazil.



Source: Research Data

Results and discussion

A total of 85 infrageneric taxa were identified, comprising 46 Rhodophyta, 18 Ochrophyta, and 21 Chlorophyta, distributed across 18 orders, 33 families, and 56 genera. The phylum Chlorophyta was represented by three orders, nine families, and 12 genera, with a predominance of the order Bryopsidales, which included the families Bryopsidaceae, Codiaceae, Caulerpaceae, and Halimedaceae. Among these, Caulerpaceae exhibited the highest species richness (four species). The genera *Caulerpa* and *Ulva* were the most speciose, with four and three species, respectively.

The phylum Ochrophyta was represented by four orders and five families, with the order Dictyotales, represented by the family Dictyotaceae, exhibiting the highest number of species (10). The genera *Dictyopteris* and *Dictyota* were the most speciose, each comprising three species.

The phylum Rhodophyta showed the greatest species diversity, encompassing 11 orders, 19 families, and 34 genera. The order Ceramiales predominated, represented by the families Ceramiaceae (five species), Rhodomelaceae (10 species), Spyridiaceae (one species), and Wrangeliaceae (one species). The most speciose genus was *Gracilaria* (six taxa), followed by *Jania* (three species).

Floristic inventory of marine benthic macroalgae from Manguinhos beach, Itaparica, Bahia, Brazil

Taxonomic arrangement of taxa according to Guiry and Guiry (2025)

RHODOPHYTA

STYLONEMATOPHYCEAE

STYLONEMATALES

Stylonemataceae

Stylonema alsidii (Zanardini) K.M.Drew

ERYTHROPELTALES

Erythrotrichiaceae

Erythrotrichia carnea (Dillwyn) J.Agardh

BANGIOPHYCEAE

BANGIALES

Bangiaceae

Pyropia acanthophora (E.C.Oliveira & Coll) M.C.Oliveira, D.Milstein & E.C.Oliveira

FLORIDEOPHYCEAE

ACROCHAETIALES

Acrochaetiaceae

Colaconema corymbiferum (Thuret) Alongi, Cormaci & G.Furnari

CORALLINALES

Corallinaceae

Amphiroa anastomosans Weber Bosse

A. fragilíssima (Linnaeus) J.V.Lamouroux

Jania pedunculata var. *adhaerens* (J.V.Lamouroux) A.S.Harvey, Woelkerling & Reviers

J. pumila J.V.Lamouroux

J. subulata (Ellis & Solander) Sonder

NEMALIALES

Galaxauraceae

Dichotomaria huismanii C.W.Schneider, Popolizio & Spagnuolo

D. obtusata (J.Ellis & Solander) Lamarck

Galaxaura rugosa (J.Ellis & Solander) J.V.Lamouroux

CERAMIALES

Ceramiaceae

Ceramium cimbricum H.E.Petersen

Ceramothamnion brasiliensis (A.B.Joly) M.J.Wynne & C.W.Schneider

C. vagans (P.C.Silva) M.J.Wynne & C.W.Schneider

Gayliella dawsonii (A.B.Joly) Barros-Barreto & F.P.Gomes

G. flaccida (Harvey ex Kützing) T.O.Cho & L.J.McIvor

Rhodomelaceae

Acanthophora spicifera (M.Vahl) Børgesen

Alsidium triquetrum (S.G.Gmelin) Trevisan

Amansia multifida J.V.Lamouroux

Digenea simplex (Wulfen) C.Agardh

Enantiocladia duperreyi (C.Agardh) Falkenberg

Halopithys schottii (W.R.Taylor) L. E. Phillips & De Clerck

Herposiphonia nuda Hollenberg

Laurencia dendroidea J.Agardh

Palisada perforata (Bory) K.W.Nam

Polysiphonia sertularioides (Grateloup) J.Agardh

Spyridiaceae

Spyridia hypnoides (Bory)

Papenfuss

Wrangeliaceae

Ptilothamnion speluncarum (Collins & Hervey) D.L.Ballantine & M.J.Wynne

GELIDIALES

Gelidiaceae

Gelidium capense (S.G.Gmelin) P.C.Silva

G. pusillum (Stackhouse) Le Jolis

Pterocladiella bartlettii (W.R.Taylor) Santelices

Gelidiellaceae

Gelidiella acerosa (Forsskål) Feldmann & Hamel

GIGARTINALES

Cystocloniaceae

Hypnea pseudomusciformis Nauer, Cassano & M.C.Oliveira

H. spinella (C.Agardh) Kützing

Gigartinaceae

Chondracanthus acicularis (Roth) Fredericq

Rhizophyllidacae

Ochtodes secundiramea (Montagne) M.Howe

Solieriaceae

Agardhiella ramosissima (Harvey) Kylin

Meristotheca gelidium (J.Agardh) E.J.Faye & M.Masuda

GRACILARIALES

Gracilariaceae

Gracilaria birdiae E.M.Plastino & E.C.Oliveira

G. caudata J.Agardh

G. cervicornis (Turner) J.Agardh

G. domingensis (Kützing) Sonder ex Dickie

G. mammillaris (Montagne) M.Howe

Gracilaria sp.

RHODYMENIALES

Champiaceae

Champia vieillardii Kützing

Rhodymeniaceae

Botryocladia occidentalis (Børgesen) Kylin

OCHROPHYTA

PHAEOPHYCEAE

DICTYOTALES

Dictyotaceae

Canistrocarpus cervicornis (Kützing) De Paula & De Clerck.

Dictyopteris delicatula J.V.Lamouroux

D. jamaicensis W.R.Taylor

D. polypodioides (A.P.De Candolle) J.V.Lamouroux

Dictyota ciliolata Sonder ex. Kützing

D. mertensii (C.Martius) Kützing

D. pulchella Hörnig & Schnetter

Lobophora variegata (J.V.Lamouroux) Womersley ex E.C.Oliveira

Padina gymnospora (Kützing) Sonder

Spatoglossum schroederi (C.Agardh) Kützing

FUCALES

Sargassaceae

Sargassum filipendula C.Agardh

S. polyceratium Montagne

S. vulgare C.Agardh

Sargassum sp.

ECTOCARPALES

Acinetosporaceae

Feldmannia mitchelliae (Harvey) H.-S.Kim

Scytosiphonaceae

Colpomenia sinuosa (Roth) Derbès & Solier

SPHACELARIALES

Sphacelariaceae

Sphacelaria tribuloides Meneghini

Sphacelaria sp.

CHLOROPHYTA

ULVOPHYCEAE

ULVALES

Ulvaceae

Ulva flexuosa Wulfen

U. lactuca Linnaeus

U. rigida C.Agardh

CLADOPHORALES

Anadyomenaceae

Anadyomene stellata (Wulfen) C.Agardh

Cladophoraceae

Chaetomorpha minima Collins & Hervey

Cladophora vagabunda (Linnaeus) C.Hoek

Cladophora sp.

Valoniaceae

Valonia macrophysa Kützing

Siphonocladaceae

Dictyosphaeria versluysii Weber Bosse

BRYOPSIDALES

Bryopsidaceae

Bryopsis pennata J.V.Lamouroux

B. plumosa (Hudson) C.Agardh

Codiaceae

Codium isthmocladum Vickers

Codium sp.

Caulerpaceae

Caulerpa cupressoides (H.West) C.Agardh

C. mexicana Sonder Ex Kützing

C. racemosa (Forsskål) J.Agardh

C. taxifolia (H.West) C.Agardh

Halimedaceae

Boodleopsis pusilla (Collins) W.R.Taylor, A.B.Joly & Bernatowicz

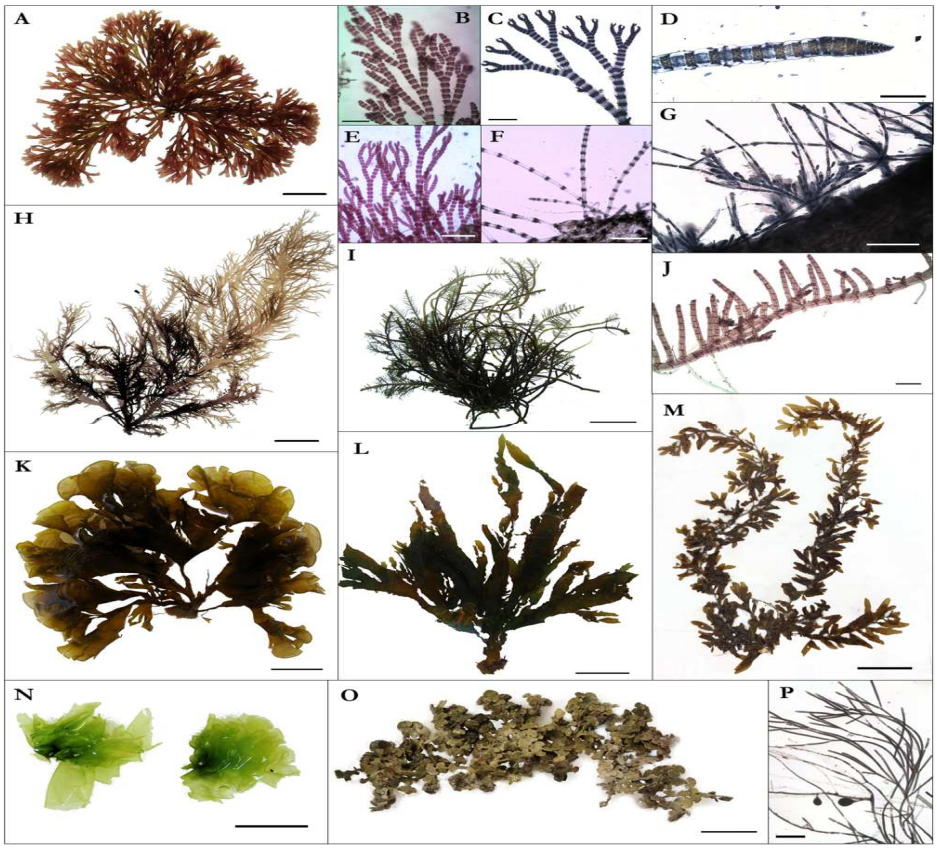
Halimeda jolyana Ximenes, Bandeira-Pedrosa, Cassano, Oliveira-Carvalho, Verbruggen & S.M.B.Pereira

H. opuntia J.V.Lamouroux

Penicillus capitatus Lammark

Species of the genera *Ceramium* (Figure 2, F), *Ceramothamnion* (Figure 2, C and D), *Gayliella* (Figure 2, B and E), *Gracilaria* (Figure 2, H) and *Sargassum* (Figure 2, M), were abundant, being found in all collections. The species *Dichotomaria huismanii* (Figure 2, A), *Halimeda opuntia* (Figure 2, O), *Hypnea pseudomusciformis*, *Padina gymnospora* (Figure 2, K), *Ulva lactuca* (Figure 2, N) and *Codium* sp. were frequent in most collections (15). *Colaconema corymbiferum* (Figure 2, G), *Herposiphonia nuda* (Figure 2, J) and *Spatoglossum schroederi* (Figure 2, L) were rarer, being collected only once.

Figure 2 - Macroalgae found on Manguinhos Beach, Itaparica, Bahia, Brazil. **A.** *Dichotomaria huismanii* (scale bar: 2 cm); **B.** *Gayliella dawsonii* (scale bar: 200 µm); **C.** *Ceramothamnion brasiliensis* (scale bar: 400 µm); **D.** *Ceramothamnion vagans* (scale bar: 200 µm); **E.** *Gayliella flaccida* (scale bar: 200 µm); **F.** *Ceramium cimbricum* (scale bar: 200 µm); **G.** *Colaconema corymbiferum* (scale bar: 60 µm); **H.** *Gracilaria domingensis* (scale bar: 4 cm); **I.** *Gelidiella acerosa* (scale bar: 2 cm); **J.** *Herposiphonia nuda* (scala bar: 300 µm); **K.** *Padina gymnospora* (scale bar: 2 cm); **L.** *Spatoglossum schroederi* (scale bar: 4 cm); **M.** *Sargassum vulgare* (scale bar: 4 cm); **N.** *Ulva lactuca* (scale bar: 2 cm); **O.** *Halimeda opuntia* (scale bar: 2 cm); **P.** *Boodleopsis pusilla* (scale bar: 400 µm).



Source: Research Data

A higher proportion of Rhodophyta (54.1%) was identified compared with the other phyla (Ochrophyta 21% and Chlorophyta 24.7%), corroborating the well-established pattern that red algae are the most abundant group in tropical regions. This trend is consistent with observations from the subtropical and tropical western Atlantic (Lüning, 1990, Little, Littler, 2000, Horta et al., 2008, Yoneshigue-Valentin, Gestinari, Fernandes, 2006, Figueiredo et al., 2008, Amado-Filho et al., 2010, Costa et al., 2012 & Moura et al., 2015). Furthermore, the presence of representatives of the orders Bryopsidales (Chlorophyta), Dictyotales (Ochrophyta), and Ceramiales (Rhodophyta) indicates the tropical character of the studied area (Guimarães, 2003, Marins et al., 2008, Figueiredo et al., 2008, Costa et al., 2012, Santos et al., 2013).

When compared with studies conducted in other island regions of the State of Bahia, the total number of species recorded in the present study is lower than that reported by Almeida (2013) for Bimbarras Island, which identified 114 taxa (53 Rhodophyta, 19 Ochrophyta, and 42 Chlorophyta), and by Moura et al. (2015) for Boipeba Island, where 159 species were recorded (83 Rhodophyta, 21 Ochrophyta, and 52 Chlorophyta). It is noteworthy, however, that these studies sampled broader areas encompassing several beaches, whereas the present inventory focused exclusively on a single site.

The macroalgal composition observed in this study does not indicate any disturbance in the sampled area, as it consists primarily of species with elaborate thalli (corticated and foliaceous), such as *Acanthophora spicifera*, *Alsidium triquetrum*, *Digenea simplex*, *Gracilaria domingensis*, *Ochtodes secundiramea*, *Canistrocarpus cervicornis*, and *Dictyopteris jamaicensis*; as well as coriaceous species (*Lobophora variegata*), filamentous forms (*Colaconema corymbiferum*, *Gayliella flaccida*, *Feldmannia mitchelliae*, among others), and articulated calcareous species (*Jania subulata*, *Halimeda opuntia*, among others). This composition suggests a climax community, consistent with the patterns described by Borowitzka (1972) and Steneck e Dethier (1994). Furthermore, several members of the order Ceramiales identified in the present study (17 taxa), particularly filamentous and corticated forms, typically occur in areas of good environmental quality (Bermejo, Vergara & Hernández, 2012).

In environmentally impacted areas, benthic communities generally lack species with more elaborate thalli, such as the genera *Alsidium*, *Dictyopteris*, *Gracilaria*, and *Halimeda*. When the flora is dominated by opportunistic species with simple morphologies and rapid growth (e.g., members of the genus *Ulva*), this condition, according to Borowitzka (1972), indicates ecological instability associated with environmental disturbance and the impairment of ecosystem functions. Under such conditions, benthic marine macroalgae typically remain at a permanent pioneer stage — a situation that was not observed in the study area.

The present study represents the first floristic inventory for the Manguinhos Beach (municipality of Itaparica), contributing to the knowledge of marine macroalgae from this region of Itaparica Island. The diversity recorded corresponds to 9.5% of the total marine macroalgal flora of Brazil and 17% of that of Bahia, based on the Flora and Funga of Brazil (Jardim Botânico do Rio de Janeiro, 2025), which lists 893 species of marine macroalgae for the country (566 Rhodophyta, 106 Ochrophyta, and 221 Chlorophyta). The macroalgae identified in this study are widely distributed along the Brazilian coast and occur naturally on the coast of Bahia, among the species already listed for the state. Nevertheless, additional floristic surveys at other beaches are imperative to encompass other parts of Itaparica Island, as well as other island systems of Bahia, many of which still represent significant gaps in the knowledge of marine biodiversity.

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