

Epiphytic macroalgae from Boa Viagem Beach, Recife, Pernambuco state, Brazil

Luanda Pereira Soares* and Mutue Toyota Fujii

Instituto de Botânica, Núcleo de Pesquisa em Ficologia. Avenida Miguel Estéfano 3687, Bairro Água Funda. CEP 04301-902. São Paulo, SP, Brazil.

* Corresponding author. E-mail: luanda87@gmail.com

ABSTRACT: The aim of this study was to carry out a taxonomic survey of epiphytic seaweeds that occur on reefs of Boa Viagem Beach, located in the metropolitan region of Recife – Pernambuco state, Brazil. The samplings were performed in the dry season (December 2009) and rainy season (April 2010) at intertidal reefs using 625 cm² squares. Voucher specimens are deposited at the Herbarium of the Instituto de Botânica, São Paulo, Brazil (SP). A total of 48 taxa were recorded of which 20 were Chlorophyta, 27 Rhodophyta and one Heterokontophyta. The most representative orders were Ceramiales and Cladophorales, with 17 and 10 taxa respectively. Nine species are new additions to the flora of Pernambucan coast. *Gelidium pusillum* (Stackh.) Le Jol. 1863 and *Chondracanthus saundersii* C. W. Schneid. and C. E. Lane 2005 had the highest number of epiphytic macroalgae. The majority of species was collected in the rainy season and on wave-exposed sites.

INTRODUCTION

Epiphytic seaweeds play an important role in the ecology of marine communities but are poorly studied in the majority of phytobenthic surveys (Levin and Mathieson 1991). These organisms are a source of food for grazers, and contribute to the increase in species richness and primary production (Elven *et al.* 2004). Epiphytism is a very common association in benthic marine communities (Kraberg and Norton 2007) and epiphytic macroalgae are often present on the thallus of perennial macroalgae (Kersen *et al.* 2011). In Brazil few studies have analyzed the macroalgae that grow as epiphytes: Ferreira-Correia (1969) recorded 36 species of epiphytic algae on *Digenea simplex* (Wulfen) C. Agardh 1822 in Ceará state; Guimarães *et al.* (1981) found 36 species on macroscopic Phaeophyceae on the continental shelf of northeastern and southeastern Brazil; Széchy and Paula (1997) listed 81 infrageneric taxa of epiphytic macroalgae in *Sargassum* C. Agardh 1820 communities of Rio de Janeiro and São Paulo; Nunes (1998) identified 23 taxa of epiphytic macroalgae in Rhodophyta from Salvador, Bahia state; Széchy and Paula (2000) recorded 152 species of macroalgae associated to beds of *Sargassum* in Rio de Janeiro and São Paulo; Lucio and Nunes (2002) found 37 taxa of epiphytic macroalgae in Rhodophyta from Guarajuba Beach, Bahia state; Széchy and Sá (2008) identified 46 species of macroalgae in a population of *Sargassum vulgare* C. Agardh 1820 in Rio de Janeiro state and, recently, Santos and Moura (2011) reported the occurrence of five new records of epiphytic macroalgae for Bahia state.

The aim of the present study was to perform a taxonomic survey of epiphytic seaweeds at Boa Viagem Beach, Pernambuco state.

MATERIALS AND METHODS

The study was carried out at the intertidal reefs of the Boa Viagem Beach, located in the metropolitan region of Recife, Pernambuco state, northeastern Brazil (08°05'26"

S, 34°52'55" W and 08°08'52" S, 34°54'23" W). This region shows a landscape characterized by several buildings, hotels, business centers and contributes significantly to tourism in the state due to the occurrence of beach rocks parallel to the coastline.

Sampling was performed during the dry season (December 2009) and rainy season (April 2010) using squares with an area of 625 cm². Twenty squares were randomly disposed along the reefs at each sampling site. The whole area of the square was scraped and the algae were placed in labeled plastic bags, and kept frozen until the analysis procedure. In the laboratory the algae were fixed and preserved in 4% formalin-seawater solution and separated for later taxonomic identification with the aid of a stereomicroscope and an optical microscope. From total of number of species identified, was obtained the percent of distribution of each order of epiphytic macroalgae. The taxonomic classification follows Wynne (2011) and the voucher specimens are deposited in the Herbarium SP of the Instituto de Botânica, São Paulo, Brazil.

RESULTS AND DISCUSSION

A total of 48 taxa were identified: 20 Chlorophyta, 27 Rhodophyta and one Heterokontophyta, distributed in 11 orders and 16 families (Table 1). The high representativity of the phylum Rhodophyta was observed in the two sampling sites and during the two seasons. Ceramiales was the most representative order with 17 taxa, followed by Cladophorales with 10 and Ulvales, with six taxa (Figure 1). The genera with the highest number of species were *Cladophora* Kütz. (6), *Ulva* L. (6), *Ceramium* Roth (5) and *Chaetomorpha* Kütz. (4). Santos *et al.* (2006) and Ribeiro *et al.* (2008) also cite that the greatest contribution comes from the phylum Rhodophyta, followed by Chlorophyta and Heterokontophyta at Boa Viagem Beach. Sousa and Coentino (2004) at Piedade Beach, south of Boa Viagem, also obtained similar results. According to Pereira *et al.* (2002) the high number of taxa of the phylum

Rhodophyta, specifically of the order Ceramiales is already a well-documented fact for the studied region and for the Brazilian coast. Széchy and Paula (1997; 2000) and Széchy and Sá (2008), found a high number of seaweeds of the phylum Rhodophyta growing on *Sargassum* beds. From Bahia state, Nunes (1998) and Lucio and Nunes (2002) also recorded more Rhodophyta growing as epiphytes. The greatest number of taxa of epiphytic macroalgae was recorded in the rainy season and in sites exposed to waves, a trend also found by Silva *et al.* (1987) and Quan-Young *et al.* (2006).

The phylum Heterokontophyta was represented by a single species, *Dictyopteria delicatula* J. V. Lamour. 1809. The small representativity of this phylum at Boa Viagem Beach and surrounding areas was also reported by other authors such as Sousa and Cocentino (2004), Santos *et al.* (2006) and Ribeiro *et al.* (2008). Berchez and Oliveira (1992) comment that the brown algae are more sensitive to pollution while the green algae are more resistant. Borowitzka (1972) and Teixeira *et al.* (1987) associate the low number or even the absence of brown algae species to toxicity of domestic and industrial effluents that are probably being released into the studied area. The presence of organic compounds of anthropogenic origin that interfere in the life cycle of such species may also cause this fact.

Boodlea composita (Harv.) F. Brand 1904, *Ceramium corniculatum* Mont. 1861, *Chaetomorpha clavata* Kütz. 1847, *Chaetomorpha nodosa* Kütz. 1849, *Chondracanthus saundersii* C. W. Schneid. and C. E. Lane 2005, *Cladophora laetevirens* (Dillwyn) Kütz. 1843, *Neosiphonia sphaerocarpa* (Borgesen) M. -S. Kim and I. K. Lee 1999, *Ulva linza* L. 1753 and *Ulva prolifera* O. F. Müll. 1778 are new occurrences for the coast of Pernambuco.

Erythrotrichia carnea (Dillwyn) J. Agardh 1883 was the epiphyte of most taxa (13), followed by *Herposiphonia tenella* C. Agardh 1880, *Hypnea musciformis* (Wulfen in Jacq.) J. V. Lamour. 1813, which were epiphyte of 11 taxa each, while *Ulva rigida* C. Agardh 1823 and *Centroceras* sp. Kütz. 1842 were epiphyte of ten and nine taxa, respectively.

A total of 30 taxa were used as substrates by the epiphytic macroalgae. Of these, *Gelidium pusillum* (Stackh.) Le Jol. (65%), *Chondracanthus saundersii* (61%) and *Palisada perforata* (Bory) K. W. Nam 2007 (44%) showed the highest number of epiphytic macroalgae. Large algae with very branched thalli were used as hosts by the majority of epiphytes, while filamentous algae with simple thalli served as hosts for only one or two taxa of epiphytic macroalgae, as was also observed by Quan-Young *et al.* (2006) for the region of Isla Mujeres, in Mexico. Schmidt and Scheibling (2006) comment that the different forms of macroalgae affect the physical and biological factors that influence the epiphytic assemblages. Small algae do not offer enough protection against grazing and abrasion caused by waves and are not able to accumulate enough particulate food to permit the settlement of the persistent epiflora. Thereby, algae with more complex thalli have a higher surface area for colonization by both animals and epiphytes.

The results obtained contribute to the knowledge of benthic biodiversity in Pernambuco state and Brazil, besides emphasizing the importance of these small epiphytic algae in floristic studies.

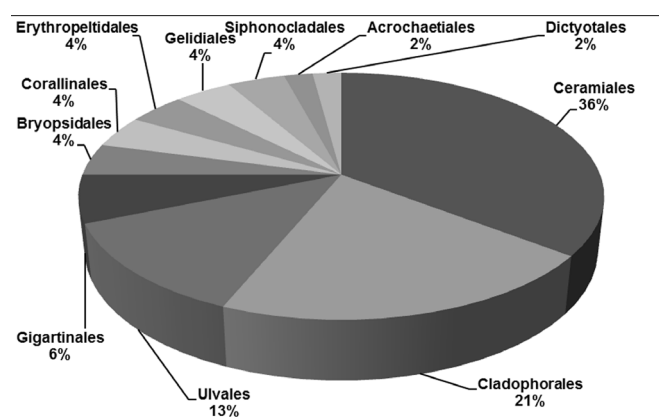


FIGURE 1. Distribution of the orders of epiphytic macroalgae found at Boa Viagem Beach, Pernambuco state, Brazil.

TABLE 1. Epiphytic macroalgae recorded at Boa Viagem Beach, Pernambuco State, Brazil.

* Voucher specimens were not possible to be obtained due to the fragility and small size of host macroalgae.

PHYLUM/ORDER/Family	Species	Season		Number in the Herbarium SP
		Dry	Rainy	
RHODOPHYTA				
ERYTHROPELTIDALES				
Erythrotrichiaceae	<i>Erythrotrichia carnea</i> (Dillwyn) J. Agardh 1883	+	+	401.198
	<i>Sahlingia subintegra</i> (Rosenv.) Kornmann 1989	+	+	*
CORALLINALES				
Corallinaceae	<i>Corallina officinalis</i> L. 1758	+	+	401.199
	<i>Jania adhaerens</i> J. V. Lamour. 1816	+	+	401.200, 401.201
ACROCHAETIALES				
Acrochaetiaceae	<i>Acrochaetium</i> sp. Nägeli in Nägeli in Cramer 1858	+	+	401.413
CERAMIALES				
Callithamniaceae	<i>Aglaothamnion</i> sp. Feldm.-Maz. 1941	+	-	401.414
	<i>Crouania attenuata</i> (C. Agardh) J. Agardh 1842	-	+	401.415

TABLE 1. CONTINUED.

PHYLUM/ORDER/Family	Species	Season		Number in the Herbarium SP
		Dry	Rainy	
Ceramiaceae	<i>Acrothamnion butleriae</i> (Collins) Kylin 1956	-	+	401.394, 401.395
	<i>Centroceras</i> sp. Kütz. 1842	+	+	401.396, 401.397
	<i>Ceramium brasiliense</i> A. B. Joly, 1957	+	-	401.416
	<i>Ceramium brevizonatum</i> var. <i>caraibicum</i> H. E. Petersen and Børgesen 1924	+	-	427.659
	<i>Ceramium codii</i> (H. Richards) Maz. 1938	-	+	401.398
	<i>Ceramium corniculatum</i> Mont. 1861	+	-	401.399
	<i>Ceramium tenerrimum</i> (G. Martens) Okamura 1921	+	-	427.660
	<i>Gayliella</i> sp. T. O. Cho, L. McIvor and S. M. Boo 2008	+	+	401.400, 401.401, 401.402
Rhodomelaceae	<i>Bryocladia cuspidata</i> (J. Agardh) De Toni 1903	+	+	401.406, 401.407
	<i>Herposiphonia secunda</i> (C. Agardh) Ambronn 1880	+	+	401.408, 401.409
	<i>Herposiphonia tenella</i> (C. Agardh) Ambronn 1880	+	+	401.410
	<i>Neosiphonia ferulacea</i> (Suhr ex J. Agardh) S. M. Guim. and M. T. Fujii 2004	+	+	401.411
	<i>Neosiphonia sphaerocarpa</i> (Børgesen) M.-S. Kim and I. K. Lee 1999	-	+	401.412
Wrangeliaceae	<i>Gymnothamnion elegans</i> (Schousb. ex C. Agardh) J. Agardh 1892	+	-	401.403
	<i>Ptilothamnion speluncarum</i> (Collins and Herv.) D. L. Ballant. and M. J. Wynne 1998	+	+	401.404, 401.405
GELIDIALES				
Gelidiaceae	<i>Gelidium pusillum</i> (Stackh.) Le Jol. 1863	-	+	401.392
Gelidiellaceae	<i>Gelidiella acerosa</i> (Forssk.) Feldmann and Hamel 1934	-	+	401.393
GIGARTINALES				
Cystocloniaceae	<i>Hypnea musciformis</i> (Wulfen in Jacq.) J. V. Lamour. 1813	+	+	401.202, 401.203
	<i>Hypnea spinella</i> (C. Agardh) Kütz. 1847	-	+	401.204
Gigartinaceae	<i>Chondracanthus saundersii</i> C. W. Schneid. & C. E. Lane 2005	+	+	401.390, 401.391
HETEROKONTOPHYTA				
DICTYOTALES				
Dictyotaceae	<i>Dictyopteris delicatula</i> J. V. Lamour. 1809	+	+	401.196, 401.197
CHLOROPHYTA				
ULVALES				
Ulvaceae	<i>Ulva compressa</i> L. 1753	+	+	401.189, 401.190
	<i>Ulva flexuosa</i> subsp. <i>flexuosa</i> Wulfen 1803	+	+	401.191
	<i>Ulva flexuosa</i> subsp. <i>paradoxa</i> (C. Agardh) M. J. Wynne 2005	-	+	401.193
	<i>Ulva linza</i> L. 1753	+	+	401.192
	<i>Ulva prolifera</i> O. F. Müll. 1778	+	+	401.194
	<i>Ulva rigida</i> C. Agardh 1823	+	+	401.195
CLADOPHORALES				
Cladophoraceae	<i>Chaetomorpha aerea</i> (Dillwyn) Kütz. 1849	+	+	401.168, 401.169
	<i>Chaetomorpha brachygona</i> Harv. 1858	+	+	401.170, 401.171
	<i>Chaetomorpha clavata</i> Kütz. 1847	-	+	401.172, 401.173
	<i>Chaetomorpha nodosa</i> Kütz. 1849	-	+	401.174
	<i>Cladophora coelothrix</i> Kütz. 1843	-	+	401.175, 401.176
	<i>Cladophora dalmatica</i> Kütz. 1843	+	+	401.177, 401.178
	<i>Cladophora laetevirens</i> (Dillwyn) Kütz. 1843	-	+	401.179, 401.180
	<i>Cladophora montagneana</i> Kütz. 1849	+	+	401.181, 401.182
	<i>Cladophora prolifera</i> (Roth) Kütz. 1843	+	+	401.183, 401.184
	<i>Cladophora vagabunda</i> (L.) C. Hoek 1963	+	+	401.185, 401.186
SIPHONOCLADALES				
Boodleaceae	<i>Boodlea composita</i> (Harv.) F. Brand 1904	+	+	401.187
	<i>Phyllocladion anastomosans</i> (Harv.) Kraft and M. J. Wynne 1996	+	+	401.188
BRYOPSIDALES				
Bryopsidaceae	<i>Bryopsis pennata</i> J. V. Lamour. 1809	+	+	401.166
	<i>Bryopsis plumosa</i> (Huds.) C. Agardh 1823	+	-	401.167

ACKNOWLEDGMENTS: LP Soares thanks the Fundação de Amparo à Ciência do Estado de Pernambuco for a Master's Student Fellowship (Proc. 1418-1.08/08) and MT Fujii thanks the Conselho Nacional de Desenvolvimento Científico e Tecnológico for a Research Productivity Fellowship (Proc. 301438/2009-9). This study received financial support from CAPES-Brazil. We are grateful to Edson Vasconcelos, Nathalia Barros and Thiago Reis for help in field work.

LITERATURE CITED

- Berchez, F.A.S. and E.C. Oliveira. 1992. Temporal changes in benthic marine flora of the Baía de Santos, SP, Brazil, over the last four decades; p. 120-131 In M. Cordeiro-Marino, M.T.P. Azevedo, C.L. Sant'anna, N.Y. Tomita and E.M. Plastino (ed.). *Algae and environment: a general approach*. São Paulo: Sociedade Brasileira de Ficologia and CETESB.
- Borowitzka, M.A. 1972. Intertidal algal species diversity and the effect of pollution. *Australian Journal of Marine and Freshwater Research* 23: 73-84.
- Ferreira-Correira, M.M. 1969. Epífitas de *Digenea simplex* (Wulfen) C. Agardh, no estado do Ceará (Rhodophyta: Rhodomelaceae). *Arquivo de Ciências do Mar* 9(1): 63-69.
- Guimarães, S.M.P.B., M. Cordeiro-Marino and N. Yamaguishi-Tomita. 1981. Deep water Phaeophyceae and their epiphytes from northeastern and southeastern Brazil. *Revista Brasileira de Botânica* 4: 95-113.
- Kersen, P., J. Kotta, M. Bucas, N. Kolesova and Z. Dekere. 2011. Epiphytes and associated fauna on the brown alga *Fucus vesiculosus* in the Baltic and the North Seas in relation to different abiotic and biotic variables. *Marine Ecology* 32(1): 87-95.
- Kraberg, A.C. and T.A. Norton. 2007. Effect of epiphytism on reproductive and vegetative lateral formation in the brown, intertidal seaweed *Ascophyllum nodosum* (Phaeophyceae). *Phycological Research* 55: 17-24.
- Levin, P.S. and A.C. Mathieson. 1991. Variation in a host-epiphyte relationship along a wave exposure gradient. *Marine Ecology Progress Series* 77: 271-278.
- Lucio, A.M. and J.M.C. Nunes. 2002. Aportación al conocimiento fenológico de las rodofíceas marinas de la playa de Guarajuba (Camaçari, Bahia) Brasil. *Botanica Complutensis* 26: 17-34.
- Nunes, J.M.C. 1998. Rodofíceas marinhas bentônicas da orla oceânica de Salvador, Estado da Bahia, Brasil. *Insula* 27: 27-37.
- Pereira, S.M.B., M.F. Oliveira-Carvalho, J.A.P. Angeiras, N.M.B. Oliveira, J. Torres, L.M.S. Gestinari, M.E. Bandeira-Pedrosa, A.L.M. Coentino, M.D. Santos, P.R.F. Nascimento and D.R. Cavalcanti. 2002. Algas Bentônicas do Estado de Pernambuco; p. 87-124 In M. Tabarelli and J.M.C. Silva (org.). *Diagnóstico da Biodiversidade de Pernambuco*. Recife: Massangana/SECTMA.
- Quan-Youn, L.L., M.A. Díaz-Martín and J. Espinoza-Avalos. 2006. Algas epífitas de Bajo Pepito, Isla Mujeres, Quintana Roo, México. *Revista de Biología Tropical* 54(2): 317-328.
- Ribeiro, F.A., A.T. Júnior, L.M. Gestinari, J. Torres, K.K.A. Lima, M.D. Santos, G.A.S.T. Lira, K.A.A. Fontes, S.M.B. Pereira and Y.Y. Valentin. 2008. Análise quali-quantitativa das populações algáceas de um trecho recifal na Praia de Boa Viagem, PE. *Oecologia Brasiliensis* 12(2): 222-228.
- Santos, A.A., A.L.M. Coentino and T.N.V. Reis. 2006. Macroalgas como indicadoras da qualidade ambiental da Praia de Boa Viagem-Pernambuco, Brasil. *Boletim Técnico Científico do CEPENE* 14(2): 25-33.
- Santos, A.A. and C.W.N. Moura. 2011. Additions to the epiphytic macroalgae flora of Bahia and Brazil. *Phytotaxa* 28: 53-64.
- Schmidt, A.L. and R.E. Scheibling. 2006. A comparison of epifauna and epiphytes on native kelps (*Laminaria* species) and an invasive alga (*Codium fragile* ssp. *tomentosoides*) in Nova Scotia, Canada. *Botanica Marina* 49(4): 315-330.
- Silva, R.L., S.M.B. Pereira, E.C. Oliveira-Filho and V.R. Eston. 1987. Structure of a bed *Gracilaria* spp. (Rhodophyta) in Northeastern Brazil. *Botanica Marina* 30: 517-523.
- Sousa, G.S. and A.L.M. Coentino. 2004. Macroalgas como indicadoras da qualidade ambiental da Praia de Piedade-PE. *Tropical Oceanography* 32(1): 1-22.
- Széchy, M.T.M. and A.D.F. Sá. 2008. Variação sazonal do epifitismo por macroalgas em uma população de *Sargassum vulgare* C. Agardh (Phaeophyceae, Fucales) da Baía da Ilha Grande, Rio de Janeiro. *Oecologia Brasiliensis* 12(2): 299-314.
- Széchy, M.T.M. and E.J. Paula. 1997. Macroalgas epífitas em *Sargassum* (Phaeophyta-Fucales) do litoral dos Estados do Rio de Janeiro e São Paulo, Brasil. *Leandra* 12: 1-10.
- Széchy, M.T.M. and E.J. Paula. 2000. Macroalgas associadas a bancos de *Sargassum* C. Agardh (Phaeophyta, Fucales) do litoral dos Estados do Rio de Janeiro e São Paulo, Brasil. *Hoehnea* 27(3): 235-257.
- Teixeira, V.L., R.C. Pereira, A.N.M. Júnior, C.M. Leitão-Filho and C.A.R. Silva. 1987. Seasonal variations in infralitoral seaweed communities under a pollution gradient in Baía de Guanabara, Rio de Janeiro (Brazil). *Ciência e Cultura* 39: 423-428.
- Van Elven, B.R., P.S. Lavery and G.A. Kendrick. 2004. Reefs as contributors to diversity of epiphytic macroalgae assemblages in seagrass meadows. *Marine Ecology Progress Series* 276: 71-83.
- Wynne, M.J. 2011. A checklist of benthic marine algae of the tropical and subtropical Western Atlantic: third revision. *Nova Hedwigia* 140: 1-166.

RECEIVED: March 2012

ACCEPTED: July 2012

PUBLISHED ONLINE: August 2012

EDITORIAL RESPONSIBILITY: Luciana Gomes Barbosa