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Short Communication

Benthic macroalgae from different microhabitats of the Paiva Beach reef, Pernambuco - Brazil

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ABSTRACT

Paiva Beach is located 15 km south of the metropolitan area of Recife in the state of Pernambuco and has been a site of real estate development projects. The objective of this study was to generate a floristic survey of the Paiva Beach reef, focusing on three microhabitats. The random manual collection of algae was performed on February 11, 2012 during low tide. The first collection station was located in the infralittoral region near the heavily trampled beach. The second collection station was also located in the infralittoral region in an area several meters from the first station but exhibiting a low level of trampling. The third collection station was located in an area of the intertidal reef flat. A total of 28 algae species were identified. Of the 28 species, fourteen (50%), eight, and six species belonged to the phyla Rhodophyta, Chlorophyta, and Heterokontophyta, respectively. Station 2 (low trampling) had the highest species richness with 18 identified species. In the cluster analysis, Station 1 (higher trampling) presented the lowest similarity (about 50%) with the other two stations, which were grouped together (similarity about 60%). This is an evidence for the more intense affect of trampling on Station 1 than at station 2 and 3. Algae, such as *Dictyota ciliolata* and *Ulva fasciata*, which were found at all sampling stations, are characteristic of impacted areas with high rates of predation. *Cladophora* sp. was found at the stations with trampling, whereas algae such as *Bryothamnion triquetum* and the calcareous *Halimeda opuntia* were common in the infralittoral region.

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INTRODUCTION

Coastal regions and reefs are susceptible to anthropogenic impacts due to the extensive concentration of population and economic activities, including port complexes as well as tourism and leisure activities. These factors can cause changes in algal communities and associated fauna, which are sensitive to human-induced changes in ecosystems [1]. For example, models that include algae and corals as primary producers in reef environments [2] can be used to study changes in fisheries. Another relevant factor in coastal environments is the competition between algae and invertebrates, which can occur due to the predominance of algae in lower mesolittoral and infralittoral regions, including eutrophic rocky shores and reef areas [3, 4, 5]. Organic pollution, one of the major threats to coastal environments, can affect the development of benthic communities, causing a decrease in species diversity and favoring opportunistic species [6].

Coastal reefs are environments of significant importance to the primary and secondary productivity of tropical regions and have a high biological diversity and a complex trophic structure. However, the rapid urban and industrial development of coastal regions has altered the structure of macroalgal communities due to anthropogenic impacts, such as trampling, organic pollution, sedimentation and overfishing. Paiva Beach is located 15 km south of the metropolitan area of Recife in the state of Pernambuco. This beach has experienced the development of real estate projects, such as the construction of homes, hotels and business centers. The objective of this study was to produce a floristic survey of the reef located in Paiva Beach, using three microhabitats adjacent to the construction site of the *Vila dos Corais* building complex.

MATERIALS AND METHODS

The study region has a tropical Atlantic climate with an average annual temperature of 26ºC and average annual rainfall of approximately 1,720 mm. Two seasons can be defined according to the rainfall distribution: the dry season (September-February), with rainfall of less than 100 mm, and the rainy season (March-August), with rainfall of greater than 100 mm [7]. The salinity and temperature of the water at the collection site were measured using a refractometer and digital thermometer, respectively.

The random manual collection of algae was performed on February 11, 2012 during low tide at three sites in Paiva Beach (8º16'S and 34°56'W). Collection station 1 was located in the infralittoral region near the heavily trampled beach. The second station was also located in the infralittoral region several meters from station 1 but with less trampling. Collection station 3 was located within the intertidal reef flat of Paiva Beach. The algae were placed in labeled plastic bags for subsequent identification. A cluster analysis of data from the various collection stations was performed using the Sorensen similarity index based on the presence or absence of species.

RESULTS AND DISCUSSION

A water salinity of 35% and temperature of 30°C, which are characteristic of the dry season, were recorded at the time of sample collection. A total of 28 species of algae were identified (Table 1),

Table 1. Algae species presence and absence at Praia do Paiva microhabitats.

Chlorophyta	**Site 1**	**Site 2**	**Site 3**
Bryopsis pennata			X
Caulerpa racemosa		X	
Caulerpa sertularioides	X	X	X
Caulerpa fastigiata	X		
Halimeda opuntia	X	X	
Cladophora sp.	X		X
Valonia aegagropila			X
Ulva fasciata	X	X	X
Heterokontophyta			
Dictyopteris delicatula	X	X	X
Dictyota bartayresii		X	X
Dictyota ciliolata	X		X
Lobophora variegata	X		
Padina gymnospora	X		X
Sargassum vulgare	X	X	X
Rhodophyta			
Bryothamnion triquetrum		X	
Laurencia spp.	X	X	X
Jania adhaerens		X	X
Jania capillacea	X	X	X
Jania sp.		X	
Gelidium floridanum		X	
Gelidium pusillum	X	X	X
Gelidiella acerosa	X	X	
Hypnea musciformis			X
Chondracanthus acicularis		X	X
Gracilaria cervicornis		X	
Cryptonemia crenulata	X		
Cryptonemia sp.	X		

including fourteen, eight and six representatives of the phyla Rhodophyta (50.0%), Chlorophyta (28.6%) and Heterokontophyta (21.4%), respectively. Station 2 (lower trampling) had the highest species richness with 18 species. Stations 1 (higher trampling) and 3 (intertidal) each had 16 species (Table 1). Only 7 (25%) species occurred simultaneously at the tree sites. In the cluster analysis, Station 1 (higher trampling) presented the lowest similarity (about 50%) with the other two stations, which were grouped together (similarity about 60%). This is an evidence for the more intense affect of trampling on Station 1 than at station 2 and 3. Algae species, such as *Dictyopteris delicatula* and *Ulva fasciata*, which are characteristic of areas impacted by organic pollution and with high predation rates, were found at all sampling stations [5, 8, 9]. *Cladophora* sp. was found at the stations with trampling, whereas algae species such as *Bryothamnion triquetrum* and the calcareous *Halimeda opuntia* were characteristic of the infralittoral region. Despite the effects of trampling, the species richness was high with the presence of algal genera that are characteristic of reef environments containing herbivores and with important community structuring roles (*Sargassum*, *Laurencia*, *Dictyota*, *Halimeda* and *Caulerpa*). Thus, it is important that monitoring studies on the diversity of benthic species as bioindicators of environmental impacts be conducted in this region.

Artificial eutrophication processes affect communities that are often dominated by benthic animals such as corals and may cause these communities to become dominated by macroalgae, which, together with the fishing of herbivorous fish, can cause changes in the benthic community structure [10, 11]. The algae species *Ulva* spp., *Centroceras clavulatum* and *Hypnea musciformis* have been cited as bioindicators of organic pollution at Boa Viagem Beach [12]. Together with biomass values that are on average higher than those at Piedade Beach [1], these bioindicators confirm the effects of eutrophication on these urbanized sites located several kilometers north of Paiva Beach. The station with the highest species richness exhibited low trampling and was characterized by the highest numbers of Rhodophyta (10 species), and by *Bryothamnion triquetrum* and *Caulerpa racemosa*, with the latter two species found only in the infralittoral region (Table 1).

The Rhodophyta *Laurencia* sp. also occurs on nearby impacted reefs, including reefs at Piedade Beach [8], which has a low number of herbivores but a high proportion of red algae in the lower mesolittoral region, similar to community of station 2 (low trampling) at Paiva Beach. Algae belonging to the phylum Heterokontophyta, including *Dictyota* and *Padina*, mainly occur as epiphytes or in tidepools on the reef flat of Piedade Beach and are characteristic of urbanized areas and sites with late successional stage communities [8, 9, 13]. The richness of brown algal species in the intertidal region is higher at sites with temperate influence [14] in contrast to our study sites. Specimens of *Sargassum* sp. were found in the infralittoral and intertidal regions of the studied reef areas. Algae of the genera *Laurencia*, *Dictyota*, *Halimeda* and *Hypnea* that were sampled in the studied reefs are also characteristic of Caribbean reefs in which the community structure is controlled by herbivores [15, 16]. The Rhodophyta were the most abundant algae at all of the sampling stations, which is in agreement with the tropical nature of the Pernambuco flora [17, 8, 9, 13].

CONCLUSION

Filamentous and foliaceous chlorophytes were reported as the first re-colonizers in succession experiments conducted in a rocky intertidal region on the west coast of Portugal [18]; while [8] reported similar results using the percent coverage evaluation method. These observations indicated the importance of the complementary use of nondestructive methods for obtaining coverage estimates in reef areas [19, 20] as a component of productivity studies. *Ulva fasciata*, which is characteristic of impacted environments, was one of the algae that occurred at all of the Paiva Beach stations. The qualitative analysis of the composition of the benthic macroalgal communities of the reefs in combination with the use of similarity analyses confirm the importance of random sampling in degraded areas that have spatial heterogeneity. In contrast, the red algae had a higher species richness at all sampling stations, confirming the tropical character of the Paiva Beach flora, whereas the high species richness demonstrates the regeneration capacity of the community, despite environmental impacts, such as trampling, sedimentation and eutrophication.

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