

**Benthic macroinvertebrates of the emerged reefs of Gaibu and Boa Viagem,
Pernambuco, Brazil****Macroinvertebrados bentônicos dos recifes emersos de Gaibu e Boa Viagem,
Pernambuco, Brasil**

DOI:10.34117/bjdv6n10-450

Recebimento dos originais: 13/09/2020

Aceitação para publicação: 21/10/2020

Deivson Chaves da Silva

Graduando de bacharelado em Ciências Biológicas

Instituição: Laboratório de Paleontologia e Sistemática, Área de Ecologia, Departamento de Biologia, Universidade Federal Rural de Pernambuco, – UFRPE.

Endereço: Dom Manuel de Medeiros, s/n, Dois Irmãos, CEP: 52171-900, Recife, Pernambuco, Brasil.

E-mail: deivson_chaves@hotmail.com

Alice Cabral Delgado Falcão

Graduanda de bacharelado em Ciências Biológicas.

Instituição: Laboratório de Oceanografia Pesqueira, Departamento de Pesca e Aquicultura, Universidade Federal Rural de Pernambuco – UFRPE.

Endereço: Dom Manuel de Medeiros, s/n, Dois Irmãos, CEP: 52171-900, Recife, Pernambuco, Brasil.

E-mail: alicecabralfalcao@hotmail.com

Fernanda Maria Duarte do Amaral

Doutora em Ciências Biológicas (Zoologia)

Instituição: Laboratório de Ambientes Recifais, Área de Zoologia, Departamento de Biologia, Universidade Federal Rural de Pernambuco – UFRPE.

Endereço: Dom Manoel de Medeiros, s/n, Dois Irmãos, CEP: 52171-900, Recife, PE, Brasil.

E-mail: fernandaduarteamaral@gmail.com

ABSTRACT

Reef environments are unique ecosystems of high ecological and anthropic importance in the economics, tourism, pharmaceutical and other areas. Fauna surveys in these environments allow us to provide knowledge for the management and conservation of these invaluable ecosystems, which are still scarce. In this work, the organisms that constitutes the invertebrate macrofauna found in the emerged reefs of Boa Viagem and Gaibu beaches from September 2018 to June 2019 were surveyed, having their characteristics recorded in the field with the aid of a stereoscopic microscope, avoiding collection and minimizing the ecological impact. A total of 108 taxa were identified at the lowest possible taxonomic level: 26 mollusks, 19 arthropods, 17 porífers, 14 cnidaria, 14 echinoderms, 6 chordates, 5 annelids, 3 bryozoans, and only 1 flatworm. This result showed that marine fauna present in a reasonable diversity of zoological organisms and groups even in places affected by impacts resulting from anthropic action.

Keywords: Biodiversity, Checklist, Reef Environment, Mediolittoral.

RESUMO

Ambientes recifais são ecossistemas únicos com alta importância ecológica e antrópica nos âmbitos econômicos, turísticos, farmacêuticos e outras áreas. A partir disso, a realização de levantamentos de fauna nestes ambientes permite o fornecimento do conhecimento para o manejo e sua conservação, que, apesar da sua relevância, ainda se encontra escasso. Neste trabalho, realizou-se o levantamento dos organismos macroinvertebrados bentônicos encontrados nos bancos recifais emersos das praias de Boa Viagem e Gaibu, no período de setembro de 2018 a junho de 2019, tendo suas características registradas, em campo, com auxílio de microscópio estereoscópico, evitando a coleta e minimizando o impacto ecológico. Foi identificado, ao menor nível taxonômico possível, o total de 108 taxa, sendo: 26 moluscos, 19 artrópodes, 17 poríferos, 14 cnidários, 14 equinodermos, 6 cordados, 5 anelídeos, 3 nemertinos, 3 briozoários e apenas 1 platelminto. Portanto, este estudo encontrou uma fauna marinha com uma razoável diversidade de organismos e grupos zoológicos, mesmo em locais acometidos por fortes impactos decorrentes da ação antrópica.

Palavras chave: Biodiversidade, Checklist, Ambiente Recifal, Mediolitoral.

1 INTRODUCTION

Reef environments are consolidated substrates that represents approximately 0.02% of the ocean area (Spalding & Grenfell, 1997) and host approximately 1/4 of marine species (Davidson, 1998). They're unique ecosystems with high ecological importance (Dight & Sherl, 1997), because of the present high biodiversity (Connell, 1978; Moberg & Folke, 1999), due to the favorable conditions for several organisms; high productivity (Birkeland, 1997; Osborne, 2000) and its important role in the energy cycle (Lasker, 1976; Smetacek, 1984; Lira et al., 2009).

The local economy of some countries benefits from recreational activities in reef environments, which are greatly influenced by biodiversity and its conservation. Reef tourism is calculated to be worth some US\$35.8 billion dollars globally (Spalding et al., 2017). However, despite the great growth and financial benefits generated by these industries, both have a negative impact on the coastal environment (Steiner et al., 2006).

Anthropic actions in these environments lead to stressful factors, such as overexploitation of resources, trampling, anchoring, ghost fishing, among others, which together with natural factors, such as warming and acidification of the oceans, leads to the degradation of this environment. Although the damage caused, the reef ecosystem still houses several organisms and phyla, being considered the most diverse marine habitats by area (Knowlton et al., 2010).

Viewing the relevance and fragility of the organisms that compose the reef community in the face of the impacts that daily affect these habitats, this study aimed to carry out a survey of the benthic macroinvertebrates of the reef plateau of Boa Viagem – location that suffers with real estate expansion, urbanization, marine pollution and disorderly tourism – and Gaibu, which despite being a touristic beach and suffer from sewage dumps, still in better environmental conditions. The choice of places to make this study considered that fauna surveys should be a constant in impacted areas.

These results can be used for certain studies, such as the analysis of temporal and spatial changes, checklists and to generate important data, which can influence projects, that have a positive or negative impact in the ecosystem, through environmental impact reports, in addition to providing information about ecosystems to the scientific community and for the population who lives around this environment (Silveira et al., 2010).

2 MATERIALS AND METHODS

2.1 STUDY AREA

Boa Viagem beach is located between the coordinates 08°06'02" and 08°08'06"S; 34°52'48" and 34°53'47"W, in the Municipality of Recife, capital of the state of Pernambuco, with an estimated population of 1.6 million inhabitants for 2019 (IBGE, 2010). It is approximately 7 km long and has

beachrocks sandstone banks 2 to 4 meters wide parallel to the coast, which can be seen at low tide. Despite its ecological and tourist importance and its proximity to educational and research institutions, there is little data about its fauna (Oliveira et al., 2009).

Gaibu beach is located between the coordinates 8°17'15"S and 35°02'00"W, belonging to the Municipality of Cabo de Santo Agostinho, located just over 30 km south of the city of Recife, still in the metropolitan region and has an estimated population of 207,048 inhabitants to 2019 (IBGE, 2010). Gaibu is bordered by the beaches of Calhetas, to the south, and Enseada dos Corais, to the north, and features a beachrock with approximately 800 meters long.

3 METHODOLOGY

Data collection was performed by active search in the littoral zone and in sublittoral cliffs, in the sandbanks of Gaibu and Boa Viagem beaches, always during low tide, in intervals of 0.0 and 0.4 (tidal data obtained from the Centro de Hidrografia da Marinha - Marinha do Brasil) when the reef bank was fully immersed and in favorable weather and sea currents.

In order to avoid repetitions in search for organisms, the beachrock of Gaibu beach was divided into 3 sites: the first being the southern area; the second in the center and, the third, to the north. Each of these sites was divided into three regions, being: a region closer to the reef front, a central region (the reef platform) and a closer to the coast. At Boa Viagem beach, the sandstone reef was divided into two sites: one to the south and the other to the north. The divisions in the reef plateaus of the beaches were used to assist in the search for organisms in a larger area of the reef, not reflecting in the results regarding the disposition of the organisms on it.

The organisms were not collected, only photographed for later identification at the lowest possible taxonomic level. Regarding corals and zoanths, the presence or absence of bleaching events were also analyzed, with the aid of the "Coral Watch" Protocol, using a "Coral Health Chart" gradient card (Siebeck et al. 2006). The materials used for data collection were a portable stereoscopic microscope modified for use solar energy, integrated with a camera to record the morphological aspects of the organisms (equipment from the Cytogenetics and Innovation Laboratory of The Federal Rural University of Pernambuco - LACI / UFRPE and handled by Dr. Reginaldo de Carvalho), a PVC plate and a pencil to record the data. To identify the organisms, relevant literature related to the organisms found and consultation with experts from each group.

4 RESULTS

It was seen that Gaibu beach has some anthropic impacts, being possible to visualize sewage, garbage and trampling spills, however, still have a greater number of benthic organisms (Figure 1)

than Boa Viagem beach (Figure 2), which is extremely degraded by anthropic activities carried out daily on the shore.

On this beach, the phylum Mollusca presented 20 species, with the class Gastropoda (11) being more representative than Polyplacophora (5), Bivalvia (3) and Cephalopoda (1); the phylum Porifera totaled 17 species of class Demospongiae; subphylum Crustacea (Arthropoda) with 13 species that were distributed in two groups: Malacostraca (11) and Hexanauplia (2); Echinodermata got 14 species, that were divided into the classes Ophiuroidea (6), Echinoidea (4), Holothuroidea (2), Crinoidea (1) and Asteroidea (1); 12 species of Cnidaria were found, which only one was identified as Hydrozoa and the remaining belongs to the class Anthozoa; 6 species of the phylum Chordata, belonging to the class Ascidiacea; phylum Annelida was represented by 4 species of the class Polychaeta; 3 species of Bryozoa, belonging to the class Gymnolaemata and phyla Nemertea and Platyhelminthes, with 1 single representative each: class Pilidiophora and class Turbellaria, respectively (Table I).

Boa Viagem beach is one of the most impacted areas of beachrocks on the entire coast of Pernambuco. The impact of the housing estate, urban expansion and the great tourist visitation was evidenced, being found a limited fauna of benthic organisms (Figure 1) in the sandstone banks of the beach.

The registered phyla, in order of the greater abundance of representatives, were phylum Mollusca, represented with 13 species, being the class Gastropoda (9) more representative than Polyplacophora (2), Bivalvia (1) and Cephalopoda (1). The subphylum Crustacea got 8 species, represented by the classes Malacostraca (7) and Hexanauplia (1); the class Anthozoa (5) was more representative than Hydrozoa (1) in the phylum Cnidaria (6), on the other hand, for the phylum Echinodermata (5) was found 2 species of the classes Ophiuroidea and Holothuroidea and 1 of the class Echinoidea; phylum Porifera got 2 species of the class Demospongiae; phylum Annelida had 3 representatives of the class Polychaeta; phylum Nemertea was represented by 2 species of the class Pilidiophora and phylum Chordata by 2 species of the class Ascidiacea (Table I).

Figure 1: Photos of some organisms that represent the benthic fauna found at Gaibu and/or Boa Viagem beaches. (A): *Eucidaris tribuloides*; (B): *Tropiometra carinata*; (C): *Ophiothrix (Ophiothrix) angulata*; (D): *Echinometra lucunter*; (E): *Amphimedon* spp.; (F): *Hesione picta*; (G): *Macrocypraea zebra*; (H): *Aplysia dactylomela*; (I): *Sertularelloides cylindriheca*; (J): *Zoanthus sociatus*; (K): *Siderastrea stellata*; (L): *Favia gravida*. Photos: Laboratório de Ambientes Recifais on Facebook.



Figure 2: Representativeness of the species of each group of benthic macroinvertebrates observed on the beaches of Gaibu and Boa Viagem and the total number of species, calculated by the number of different species on the two beaches.

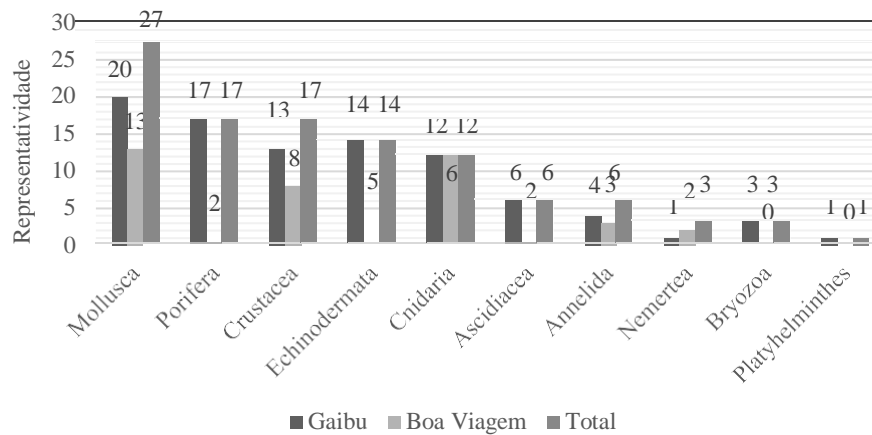


Table I: List and distribution of the benthic macroinvertebrates studied on the Gaibu and Boa Viagem beaches, observed from September 2018 to August 2019, where + indicates presence and - indicates absence.

Filo	Taxa	Gaibu	Boa Viagem
Mollusca			
Class Gastropoda	<i>Janthina janthina</i> (Linnaeus, 1758)	+	-
	<i>Micromelo undatus</i> (Bruguère, 1792)	+	-
	<i>Aplysia dactylomela</i> Rang, 1828	+	+
	<i>Aplysia parvula</i> Mörch, 1863	-	+
	<i>Aplysia brasiliana</i> Rang, 1828	+	-
	<i>Echinolittorina lineolata</i> (d'Orbigny, 1840)	+	+
	<i>Discodoris branneri</i> MacFarland, 1909	+	-
	<i>Macrocypraea zebra</i> (Linnaeus, 1758)	+	-
	<i>Luria cinerea</i> (Gmelin, 1791)	+	-
	<i>Decipifus sixaolus</i> Olsson & McGinty, 1958	+	+
	<i>Hastula cinerea</i> (Born, 1778)	-	+
	<i>Neoterebra protexta</i> (Conrad, 1846)	-	+
	<i>Tegula viridula</i> (Gmelin, 1791)	-	+
	<i>Lithopoma americanum</i> (Gmelin, 1791)	+	-
	<i>Vitta virginea</i> (Linnaeus, 1758)	+	-
	<i>Pusula pediculus</i> (Linnaeus, 1758)	-	+
	<i>Fissurella clenchi</i> Farfante, 1943	-	+
Class Polyplacophora	<i>Ischnoplax pectinata</i> (GB Sowerby II, 1840)	+	-
	<i>Leptoplax curvisetosa</i> (Leloup, 1960)	-	+
	<i>Ischnochiton striolatus</i> (Gray, 1828)	+	-
	<i>Ischnochiton yerburyi</i> (E. A. Smith, 1891)	+	+
	<i>Tegulaplax hululensis</i> (E. A. Smith, 1903)	+	-
	<i>Callistochiton laticostatus</i> Kaas & Van Belle, 1994	+	-
Class Bivalvia	<i>Atrina seminuda</i> (Lamarck, 1819)	+	-
	<i>Anomalocardia flexuosa</i> (Linnaeus, 1767)	+	-
	<i>Mytilaster solisianus</i> (d'Orbigny, 1842)	+	+
Class Cephalopoda	<i>Octopus vulgaris</i> Cuvier, 1797	+	+
Porifera			
Class Demospongiae			
Subclass Heteroscleromorpha	<i>Amphimedon viridis</i> Duchassaing & Michelotti, 1864	+	-
	<i>Amphimedon</i> sp.	+	-
	<i>Cinachyrella alloclada</i> (Uliczka, 1929)	+	+
	<i>Terpios fugax</i> Duchassaing & Michelotti, 1864	+	-

	<i>Tedania (Tedania) ignis</i> (Duchassaing & Michelotti, 1864)	+	-
	<i>Cliona delitrix</i> Pang, 1973	+	+
	<i>Haliclona (Soestella) melana</i> Muricy & Ribeiro, 1999	+	-
	<i>Haliclona (Reniera) manglaris</i> Alcolado, 1984	+	-
	<i>Axinella corrugata</i> (George & Wilson, 1919)	+	-
	<i>Hymeniacion perlevis</i> (Montagu, 1814)	+	-
	<i>Halichondria (Halichondria) panicea</i> (Pallas, 1766)	+	-
	<i>Erylus formosus</i> Sollas, 1886	+	-
	<i>Chalinula molitba</i> (de Laubenfels, 1949)	+	-
	<i>Scopalina ruetzleri</i> (Wiedenmayer, 1977)	+	-
	<i>Tethya aurantium</i> (Pallas, 1766)	+	-
Subclass Verongimorpha	<i>Chondrilla nucula</i> Schmidt, 1862	+	-
Subclass Keratosa	<i>Dysidea fragilis</i> (Montagu, 1814)	+	-
Arthropoda			
Class Malacostraca	<i>Sesarma</i> sp.	+	+
	<i>Scyra</i> sp.	+	-
	<i>Mithrax hispidus</i> (Herbst, 1790)	+	-
	<i>Mithrax</i> sp.	+	-
	<i>Clibanarius antillensis</i> Stimpson, 1859	+	+
	<i>Platypodiella spectabilis</i> (Herbst 1794)	+	-
	<i>Schizophrys aspera</i> (H. Milne Edwards, 1834)	+	-
	<i>Petrolisthes galathinus</i> (Bosc, 1801)	+	-
	<i>Eriphia gonagra</i> (Fabricius, 1781)	+	+
	<i>Parribacus antarcticus</i> (Lund, 1793)	+	-
	<i>Callinectes danae</i> Smith, 1869	-	+
	Majidae	-	+
	<i>Atergatis</i> sp.	-	+
	<i>Pachygrapsus transversus</i> (Gibbes, 1850)	-	+
	<i>Odontodactylus brevis</i> (Miers, 1884)	+	-
Class Hexanauplia	<i>Balanus</i> sp.	+	+
	<i>Megatrema madreporarum</i> (Bosc, 1812)	+	-
Cnidaria			
Class Anthozoa	<i>Protopalythoa variabilis</i> (Duerden, 1898)	+	+
	<i>Palythoa caribaeorum</i> (Duchassaing & Michelotti, 1860)	+	-
	<i>Zoanthus sociatus</i> (Ellis, 1768)	+	+
	<i>Siderastrea stellata</i> Verrill, 1868	+	-
	<i>Favia gravida</i> Verrill, 1868	+	-
	<i>Astrangia solitaria</i> (Le Sueur, 1818)	+	-
	<i>Carijoa riisei</i> (Duchassaing & Michelotti, 1860)	+	+
	<i>Epizoanthus scotinus</i> Wood, 1957	+	-
	<i>Bunodosoma cangicum</i> Belém & Preslercravo, 1973	+	+
	<i>Anthopleura cascaia</i> Corrêa, 1973	+	+
	<i>Actinostella flosculifera</i> (Le Sueur, 1817)	+	-
Class Hydrozoa	<i>Sertularelloides cylindricus</i> (Allman, 1888)	+	+
Echinodermata			
Class Echinoidea	<i>Echinometra lucunter</i> (Linnaeus, 1758)	+	+
	<i>Eucidaris tribuloides</i> (Lamarck, 1816)	+	-
	<i>Lytechinus variegatus</i> (Lamarck, 1816)	+	-
	<i>Mellita quinquesperforata</i> (Leske, 1778)	+	-
Class Ophiuroidea	<i>Ophiothrix (Ophiothrix) angulata</i> (Say, 1825)	+	-
	<i>Ophiactis savignyi</i> (Müller & Troschel, 1842)	+	+
	<i>Ophionereis reticulata</i> (Say, 1825)	+	-
	<i>Ophioderma</i> sp.	+	+
	<i>Ophioderma apressum</i> (Say, 1825)	+	-
	<i>Ophioderma cinereum</i> Müller & Troschel, 1842	+	-
Class Holothuroidea	<i>Holothuria grisea</i> Selenka, 1867	+	+
	<i>Holothuria</i> sp.	+	+
Class Asteroidea	<i>Linckia guildingi</i> Gray, 1840	+	-

Class Crinoidea	<i>Tropiometra carinata</i> (Lamarck, 1816)	+	-
Chordata			
Class Ascidiacea			
Order Stolidobranchia	<i>Botrylloides niger</i> Herdman, 1886	+	-
	<i>Styela canopus</i> (Savigny, 1816)	+	-
	<i>Herdmania pallida</i> (Heller, 1878)	+	-
Order Aplousobranchia	<i>Lissoclinum perforatum</i> (Giard, 1872)	+	+
	<i>Didemnum</i> sp.	+	+
	<i>Eudistoma</i> sp.	+	-
Annelida			
Class Polychaeta			
Subclass Sedentaria	<i>Branchiomma nigromaculatum</i> (Baird, 1865)	+	-
	<i>Eupolymnia nebulosa</i> (Montagu, 1819)	-	+
Subclass Errantia	<i>Hesione picta</i> Müller in Grube, 1858	+	+
	<i>Hermodice carunculata</i> (Pallas, 1766)	+	-
	<i>Lumbrineris latreilli</i> Audouin & Milne Edwards, 1833	-	+
Subclass Echiura	<i>Ochetostoma decameron</i> (Lanchester, 1905)	+	-
Nemertea			
Class Pilidiophora	Valenciniidae	+	-
	Valenciniidae	-	+
	Valenciniidae	-	+
Bryozoa			
Class Gymnolaemata	Flustrina	+	-
	Flustrina	+	-
	<i>Tricellaria</i> sp.	+	-
Platyhelminthes			
Order Polycladida	<i>Pseudobiceros splendidus</i> (Lang, 1884)	+	-

5 DISCUSSION

Malacofauna was predominant among the observed phyla, represented by 27 species and composing $\pm 25\%$ of a total of 106 taxa found on the two beaches. Despite having the greatest representation in Boa Viagem beach, the numbers are low when compared to previous studies, such as the research by Mello & Perrier (1986), that studied shellfish from Boa Viagem and Suape beaches and quantified, only at Boa Viagem, a total of 114 mollusks, distributed in the classes Gastropoda (109) and Polyplacophora (5). The huge discrepancy between the results shows that, in 33 years, the acceleration of degrading processes of the environment, associated with ocean warming, acidification and pollution of urban beaches, besides others stressors, led to the disappearance of some local species.

Compared to recent studies, this survey showed half of the organisms found by Vasconcelos (2018), which identified the class Polyplacophora (6) for the reefs of Boca da Barra, Itamaracá (PE); a single species of class Bivalvia in common with the studies by Barboza (2014), which characterized the benthic community of the Pirangi reef (RN) and, excluding the gastropod *Aplysia brasiliiana* (Rang 1828) and the Polyplacophora *Ischnoplax pectinata* (GB Sowerby II 1840), *Leptoplax curvisetosa* (Leloup 1960), *Ischnochiton yerburyi* (EA Smith 1891) and *Tegulaplax hululensis* (EA Smith 1903), the other mollusks identified in this study were also recorded along

reefs in the northeastern coast, such as Itamaracá (Métivier, 1972), Barra de Jangadas, Tamandaré, Rio Formoso (Matthews & Coelho, 1975), Suape (Fernandes, 1990; Mello & Perrier, 1986), Fernando de Noronha and other regions of Brazil (Rios, 1994).

Some previous studies have been made about the diversity of crustaceans in Pernambuco, such as Coelho et al. (2002), which found a total of 740 species: 45 of them in Boa Viagem beach. This study identified 7 different decapod taxa in Boa Viagem beach, which 6 had been mentioned in the literature. The genus *Atergatis* De Haan 1833, was not found on the reefs of Boa Viagem before this study, registering a new occurrence for this species. Only one cirripedium was found in Boa Viagem beach and two Gaibu beach, these were also recorded by Coelho et al. (2002).

As for Gaibu beach, were found 11 decapod taxa, which 8 have already been mentioned in the literature along the reefs of Tamandaré (Young, 1988), Porto de Galinhas (Coelho, 1971; Young 1988), Serrambi (Young, 1988), Boa Viagem, Piedade and Janga (Coelho, 1971), besides other locations (Coelho et al., 2002), with the exception of *Scyra* sp.; *Schizophrys aspera* (H. Milne Edwards 1834) and *Eriphia gonagra* (Fabricius, 1781). On Pirangi's reefs, Barboza (2014) found 6 crustaceans during its characterization, sharing with this research only the genus: *Eriphia*, *Clibanarius* and *Pachygrapsus*.

The porifers found at Gaibu beach correspond to the same number of species identified in total (17) which only 2 were observed in Boa Viagem: *Cinachyrella alloclada* (Uliczka, 1929) – also recorded by Santos et al. (2002a), for the reefs of Boa Viagem beach – and *Cliona delitrix* Pang, 1973, which was not recorded by these studies in the state of Pernambuco, being only recorded the species: *Cliona carteri* (Ridley, 1881), in the Archipelago of Fernando de Noronha (Mothes & Bastian 1993); *Cliona* cf. *celata* Grant, 1826, in Tamandaré (Muricy & Moraes, 1998); *Cliona dioryssa* De Laubenfels, 1950; *Cliona carpenteri* Hancock, 1849 and *Cliona schmidtii* (Ridley, 1881) (Santos et al., 2002a).

With exception of taxa *Terpios fugax* Duchassaing & Michelotti, 1864; *Scopalina ruetzleri* (Wiedenmayer, 1977) and *Cliona delitrix* Pang, 1973, all the porifers found were registered for the state of Pernambuco in several reefs, such as the Fernando de Noronha Archipelago, Recife and others (see: Hechtel, 1976; Mothes & Bastian, 1993; Muricy & Moraes, 1998; Santos et al., 2002a; Santos et al., 2002b; Milton, 2011).

This study also adds the presence of porifera species to the Gaibu beach. Milton (2011) made a survey that registered only 6 species of sponges identified, where 3 of them were not found in the present study: *Cliona dioryssa* de Laubenfels, 1950, *Dragmacidon reticulatus* (Ridley & Dendy, 1886) and *Amphimedon compressa* Duchassaing & Michelotti, 1864, which only this last genus was also observed during this research.

According to Fernandes et al. (2002) and Lima & Fernandes (2009), 35 species of echinoderms have already been identified for the State of Pernambuco, with 5 species between Recife and Olinda, 2 in Boa Viagem and 16 species between Gaibu, Calhetas and Suape beaches, being 12 species only in Gaibu. In this present study, 5 echinoderms were found for Boa Viagem beach: *Echinometra lucunter* (Linnaeus, 1758), that was also found in previous studies. However, there was not presence of *Mellita quinquiesperforata* (Leske, 1778), not corroborating with the results of Lima & Fernandes (2009) who registered the 2 species at Boa Viagem beach and there also was not presence of *Encope emarginata* (Leske, 1778) and *Ophiothrix (Ophiothrix) angulata* (Say, 1825), which were recorded by Fernandes et al. (2002), between Olinda and Recife.

Although this study has a larger number of species, only 10 of the 12 organisms surveyed by Lima & Fernandes (2009) were observed, with the absence of starfish *Luidia senegalensis* (Lamarck, 1816) and *Echinaster (Othilia) echinophorus* (Lamarck, 1816), found in Boa Viagem and, in addition to the aforementioned starfish, there was also an absence of *Tripneustes ventricosus* (Lamarck, 1816), *Chiridota rotifera* (Pourtalès, 1851) and *Ophiocnida loveni* (Ljungman, 1867), which were recorded by Fernandes et al. (2002), between the beaches of Gaibu, Calhetas and Suape. Gaibu beach presented 14 echinoderms, corresponding to the totality of species recorded in this study and have also been mentioned previously along the coast of the north and northeast regions of Brazil (Albuquerque, 1986).

According to researches made by Laborel (1970), Castro & Pires (2001), Mayal et al. (2002a) and Prates (2003), 15 different species of scleractinian corals can be found in the coastal reefs of the state of Pernambuco and, despite this relative diversity of coral species, the reefs of Boa Viagem beach did not present any scleractinian coral, in agreement with the publication by Amaral et al. (2019), however, going against the results presented by Laborel in 1969, who mentioned that the abundance of *Siderastrea stellata* Verrill, 1868 in this area was so significant, that this coral was used in lime kilns and in the construction of fortifications.

In Gaibu beach, there was the presence of the corals *S. stellata*, *Favia gravida* Verrill, 1868 and *Astrangia solitaria* (Le Sueur, 1818). However, with the aid of the “Coral Watch” protocol, total and partial bleaching was observed in some colonies of *F. gravida*, *S. stellata* and the zoanthid *Protopalythoa variabilis* (Duerden, 1898), which indicates they are exposed to stresses in the habitat, leading to the breaking of the symbiotic relationship between zooxanthellae and corals, leaving them weak and vulnerable (Glynn, 1993).

Besides to corals, this study also recorded the presence of the octocoral *Carijoa riisei* (Duchassaing & Michelotti, 1860) at both study areas, which was also found by Castro (1990), at Tamandaré beach, and the hydroid *Sertularelloides cylindritheca* (Allman, 1888) recorded by Mayal

et al. (2002b) as *Sertularella cylindriotheca* Allman 1888, for the beaches of Tamandaré, Suape, Ponta de Pedras, Paiva, Piedade, Boa Viagem and Itamaracá.

The sea anemones *Bunodosoma cangicum* Belém & Preslercravo (1973) and *Anthopleura cascaia* Corrêa (1973) were found at Boa Viagem beach, corroborating with Melo & Amaral (2005), who identified, including the mentioned, five anemones for Boa Viagem beach. Gomes & Mayal (1997) recorded the occurrence of eight species, including the three found in this study, along the coast of Pernambuco: *B. cangicum* on the beaches of Bairro Novo, Boa Viagem, Piedade, Enseada dos Corais, Serrambi and Carneiros; *A. cascaia*, on the beaches of Boa Viagem and Carneiros and *Actinostella flosculifera* (Le Sueur, 1817), on the beaches of Boa Viagem, Enseada dos Corais and Maracaípe.

The sea squirts surveyed in this study were also recorded previously along the Brazilian coast. There is few data about the fauna of Ascidiacea on the coast of the Northeast, so this study also compared with data found for the State of São Paulo, being: four species of the genus *Eudistoma*, between Alagoas, Pernambuco, Paraíba and Ceará; three species in Bahia, one in Espírito Santo (Lotufo, 2002) and one in São Sebastião (SP) (Rocha et al., 2011); *Herdmania pallida* (Heller, 1878) found in Ubatuba, São Sebastião, Guarujá, Santos (SP) (Lotufo, 2002); *Lissoclinum perforatum* (Giard, 1872), in São Sebastião (SP) (Lotufo, 2002), Paraíba and Ceará (Lotufo, 2002); for the genus *Didemnum*, twelve species were found in different locations in the state of São Paulo (Rocha et al., 2011), nine species in Bahia; eight in Rio de Janeiro; seven between Alagoas and Pernambuco; six between Paraíba and Ceará and five in Espírito Santo (Lotufo, 2002); *Botrylloides niger* Herdman, 1886, in São Sebastião, Santos, Guarujá and São Vicente (SP) (Rocha et al., 2011), Rio de Janeiro, Espírito Santo, Bahia, Alagoas and Pernambuco (Lotufo, 2002); *Styela canopos* (Savigny, 1816), registered in São Sebastião, Santos, Guarujá (SP) (Rocha et al., 2011), Rio de Janeiro, Bahia, Alagoas, Pernambuco, Paraíba and Ceará (Lotufo, 2002).

Some studies can be found pointing species of polychaetes in almost all Brazilian coast. In the present study, six species were identified, with published data on three of them: *Eupolymnia nebulosa* (Montagu, 1819), registered in São Paulo (Paiva, 1993), *Hermodice carunculata* (Pallas, 1766), which Amaral & Nonato (1994) registered for the State of Pernambuco and, for Recife (PE), by Lira et al. (2010) and also *Hesionia picta* Müller in Grube, 1858, which has data in Alagoas and Sergipe (Nonato & Luna, 1970).

Studies of fauna surveys have an emphasis on specific groups and, therefore, surveys that propose the characterization of fauna or flora in certain ecosystems, such as the present study, are important, since they gather information about different groups. The absence of survey works causes some groups to have scarce data about their distribution, which is the case of the other phyla found

in this study, with very few studies related to their fauna being observed in the literature. Among the few studies found on the phylum Bryozoa, it is worth mentioning Machado & Souza (1994), who pointed out the genus *Tricellaria* with distribution to Atol das Rocas and, therefore, this study updates the data of the genus for the State of Pernambuco; Vieira et al. (2008), who reported 53 species of the suborder Flustrina only for the northeast region - this study having raised 2 species of this suborder for Gaibu; Vieira (2008) who surveyed 20 species belonging to the Suborder Flustrina for the coast of Maceió (AL). Bahia et al. (2012) surveyed turbellarian data for Rio Grande do Norte, and the current study found the species *Pseudobiceros splendidus* (Lang, 1884), which had no published data for Brazil.

6 CONCLUSION

In general, Gaibu beach presented a greater diversity of organisms, with only the phylum Nemertea presenting a smaller number of species. This result was expected, since anthropogenic factors are present in these locations, however, they are even more evident in Boa Viagem beach, which is part of the coast of the capital of the State of Pernambuco and suffers much more from the effects of urbanization. In addition, most of the organisms found in the reef plateau of Boa Viagem beach were macroalgae, which as mentioned by Santos et al. (2020), is related to the high levels of nutrients in urbanized areas and they are bioindicators of water quality and are also capable of accumulating metals and indicating eutrophication, becoming polluters themselves (Lourenço & Marques Jr., 2002). Despite the impacts, this study showed that even in reefs that suffer from high levels of urbanization, marine fauna was present in a reasonable diversity of organisms and zoological groups, corroborating the studies by Knowlton et al. (2010).

ACKNOWLEDGMENTS

We would like to thank the Professor of the Departamento de Biologia of the UFRPE, Reginaldo de Carvalho, for his invaluable help during data collection, assisting in the identification of organisms through his portable stereoscopic microscope. To colleagues and friends Carlos Souza and Natanael Cicero from the Laboratório de Ambientes Recifais, who contributed in the field studies and also with important suggestions at work. To the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), for the granting of the Scientific Initiation scholarship from the first author that allowed this study to be carried out.

REFERENCES

- Agostini, V. O & Ozorio C. P. 2018. Caracterização da macrofauna de substratos consolidados do Litoral Norte do Rio Grande do Sul, Brasil. *Arq Ciênc Mar* 51: 26-48.
- Amaral, A. C. Z & Nonato, E. F. 1994. Anelídeos poliquetos da costa brasileira. 5. Pisionidae, Chrysopetalidae, Amphinomidae e Euphrosinidae. *Rev Bras Zool* 11 2: 361-390.
- Amaral, F. M. D.; Lima, K. K. M.; Silva, D.C.; Cordeiro, R.T.S. 2019. Ambientes coralíneos de Olinda a Recife (PE). In: Laborel, D. F., Castro, C. B., Nunes, F. L. D.; Pires, D. O. (Org.). *Recifes brasileiros: o legado de Laborel*. 1ed. Rio de Janeiro: Museu Nacional 64: 136-137.
- Albuquerque, M. N. 1986. Ophiuroidea Gray, 1840 (Echinodermata) da plataforma continental do Norte e Nordeste do Brasil. Tese de Doutorado. Universidade de São Paulo. 409p.
- Bahia, J.; Padula, V.; Delgado, M. 2012. Five new records and morphological data of polyclad species (Platyhelminthes: Turbellaria) from Rio Grande do Norte, Northeastern Brazil. *Zootaxa* 1: 31-44.
- Barboza, A. R. P. 2014. Caracterização da comunidade bentônica do recife raso de Pirangi/RN, Brasil, e avaliação do seu processo de estruturação sob impacto de pisoteio. 80f. Dissertação (Mestrado em Ecologia) - Centro de Biociências, Universidade Federal do Rio Grande do Norte, Natal.
- Birkeland, C. 1997. *Life and death of coral reefs*. 1st edition. New York, NY: Chapman & Hall.
- Castro, C. B. & Pires, D. O. 2001. Brazilian Coral Reefs: What we already know and what is still missing. *Bull Mar Sci* 68: 1-15.
- Coelho, P. A. 1971. Nota prévia sobre os Majidae do norte e nordeste do Brasil (Crustacea, Decapoda). *Arch Mus Nac* 54: 137-143.
- Coelho, P. A.; Santos, M. A. C.; Torres, M. F. A.; Monteiro, B. R. & Almeida, V. A. K. 2002. Reino Animalia: Filo (ou Subfilo) Crustacea no estado de Pernambuco. In: Tabarelli, M.; Silva, J. M. C. (org), *Diagnóstico da biodiversidade de Pernambuco*. Editora Massangana, Recife. 2: 429-482.
- Connell, J. H. 1978. Diversity in tropical rain forests and coral reefs. *Science* 199: 1302-1310.
- Davidson, O. G. 1998. *The enchanted braid. Coming to the terms with nature on the Coral Reef*. New York: JWS: 269 p.
- Dight, I. J & Scherl, L. M. 1997. The International Coral Reef Initiative (ICRI): global priorities for the conservation and management of coral reefs and the need for partnerships. *Coral Reefs* 16: 139-147.
- Fernandes, M. L. N. 1990. Moluscos Gastropoda do complexo estuarino lagunar de Suape, PE (Sistemática e Ecologia). Mestrado em Oceanografia Biológica, Universidade Federal de Pernambuco (Dissertação), Recife. 182pp.

- Fernandes, M. L. B.; Tommasi, L. R. & Lima, E. J. B. 2002. Filo Echinodermata de Pernambuco. In: Tabarelli, M. & Silva, J. M. C. (Org.). Diagnóstico da Biodiversidade de Pernambuco. Recife - PE: Massangana 2: 405-427.
- Glynn, P. W. 1993. Coral reef bleaching: Ecological perspectives. *Coral Reefs* 12: 1-17.
- Gomes, P. B & Mayal, E. M. 1997. Levantamento preliminar das anêmonas-do-mar (Cnidaria, Actiniaria) da costa de Pernambuco, Brasil. *Biociências* 6 2: 185-187.
- Hechtel, G. 1976. Zoogeography of Brazilian Marine Demospongiae. In: Harrison, F. W. & Cowden, R. R. (eds). *Aspects of Sponge Biology*, Academic Press, New York: pp. 237-259.
- IBGE - Instituto Brasileiro de Geografia e Estatística. Censo Demográfico. 2010. Disponível em: <<https://cidades.ibge.gov.br/>>. Acesso: em 15.02.2019.
- Knowlton, N.; Brainard, R. E.; Fisher, R.; Moews, M.; Plaisance, L. & Caley, M. J. 2010. Coral Reef Biodiversity. In: Mcintyre, A. D. *Life in the World's Ocean: Diversity, Distribution and Abundance*. 1 ed. United Kingdom: Blackwell Publishing 4: 65-77.
- Laborel, J. 1969. Lês peuplements de madréporaires des cotes tropicales du Brésil. *Annales de l'Université d'Abidjan, ABJ, Série E-II, fascicule 3*.
- Laborel, J. 1970. Madréporaires et hydrocoralliaires récifaux des côtes brésiliennes. *Systématique, écologie, répartition verticale et géographique*. *Ann Inst océanogr* 47 1: 15-229.
- Lasker, H. R. 1976. Intraspecific variability of zooplankton feeding in the hermatypic coral *Montastrea cavernosa*. In: Ginsburg, R. N & Taylor, D. L eds. *Proceedings of Third International Coral Reef Symposium, Rosenstiel School of Marine and Atmospheric Science*. Miami, FL: University of Miami Press 1: 607-613.
- Lima, E. J. B & Fernandes, M. L. B. 2009. Diversidade de equinodermos (Echinodermata) no Estado de Pernambuco (Brasil). *Rev Bras Zool* 11 1: 55-63.
- Lira, A. K. F.; Naud, J. P.; Gomes, P. B.; Santos, A. M. & Perez, C. D. 2009. Trophic ecology of the octocoral *Carijoa riisei* from littoral of Pernambuco, Brazil. I. Composition and spatio-temporal variation of the diet. *J Mar Biol Assoc UK* 98: 89-99.
- Lira, S. M. A.; Farrapeira, C. M. R.; Amaral, F. M. D. & Ramos, C. A. C. 2010. Sessile and sedentary macrofauna from the Pirapama Shipwreck, Pernambuco, Brazil. *Biota Neotrop* [online] 10 4: 0-0.
- Lotufo, T. M. C. 2002. Ascidiacea (Chordata: Tunicata) do litoral tropical brasileiro. Tese de doutorado, Instituto de Biociências, Universidade de São Paulo. 183pp.
- Lourenço, S. O. & Marques, J. R. A. N. 2002. Produção primária marinha. In: Pereira, R. C. & Soares-Gomes, A. (Org.), *Biologia marinha*. Editora Interciência, Rio de Janeiro: pp. 195-227.
- Machado, A. J. & Souza, F. B. C. 1994. Principais espécies de foraminíferos e briozoários do Atol das Rocas. *Braz J Geol* 24 4: 247-261.

- Matthews, H. R. & Coelho, A. S. 1975. Superfamília Tonnacea do Brasil. IV - Família Cassidae (Mollusca, Gastropoda). Arch Mus Nac, Rio de Janeiro 55: 85-104.
- Mayal, E. M.; Afonso, A. P. S.; Pinheiro, B. R. & Oliveira, C. M. S. 2002a. Corais (Scleractinia: Cnidaria) do Estado de Pernambuco. In: Tabarelli, M. & Silva, J. M. C. (Org.). Diagnóstico da Biodiversidade de Pernambuco. Recife - PE: Massangana 2: 369-374.
- Mayal, E. M.; Pena, O.; Rodrigues, E. 2002b. Hidróides do Estado Pernambuco. In: Tabarelli, M. & Silva, J. M. C. (Org.). Diagnóstico da Biodiversidade de Pernambuco. Recife - PE: Massangana 2: 375-384.
- Mello, R. L. S & Perrier, L. L. 1986. Polyplacophora e Gastropoda do litoral sul de Pernambuco, Brasil. Cad Ômega, Sér Ciênc Aquát, - Recife 2: 107-144.
- Melo, K. V. & Amaral, F. D. 2005. Ampliação da distribuição das anêmonas-do-mar (Cnidaria, Actiniaria) no Estado de Pernambuco, Brasil. Trop Oceanogr, Recife 33 1: 19-31.
- Métivier, B. 1972. Fissurellidae (Mollusca, Gastropoda) do Norte e Nordeste do Brasil. Lista preliminar. Trabalhos de Oceanografia, Universidade Federal de Pernambuco. v. 13, pp. 61-70.
- Milton, R. P. S. J. 2011. Sponge fauna of the Gaibú Beach, Cabo de Santo Agostinho, Pernambuco, Brazil. Revista CEPSUL - Biodiversidade e Conservação Marinha 2: 22-29.
- Moberg, F. & Folke, C. 1999. Ecological goods and services of coral reef ecosystems. Ecol Econ 29: 215-233.
- Mothes, B. & Bastian, M. C. K. A. 1993. Esponjas do Arquipélago de Fernando de Noronha, Brasil (Porifera, Demospongiae). Iheringia, Sér Zool, Porto Alegre 75: 15-31.
- Muricy, G. & Moraes, F. C. 1998. Marine sponges of Pernambuco State, NE, Brazil. Braz J Oceanogr, São Paulo 46: 213-217.
- Nonato, E. F. & Luna, J. A. C. 1970. Anelídeos poliquetas do Nordeste do Brasil. I - Poliquetas bentônicos da costa de Alagoas e Sergipe. Bol Inst Oceanogr, São Paulo 19: 57-130.
- Oliveira, A. C. S.; Steiner, A. Q.; Amaral, F. D. & Santos, M. F. A. V. 2009. Percepção dos ambientes recifais da praia de Boa Viagem (Recife/PE) por estudantes, professores e moradores. Ciênc Tecnol 9 2: 136.
- Osborne, P. L. 2000. Tropical ecosystems and ecological concepts. 1st edition. New York, NY: Cambridge University Press.
- Paiva, P. C. 1993. Anelídeos poliquetas da plataforma continental norte do Estado de São Paulo: I - Padrões de densidade e diversidade específica. Bol Inst Oceanogr, São Paulo 41 1/2: 69-80.
- Prates, A. P. L. 2003. Atlas dos Recifes de Coral nas Universidades de Conservação Brasileiras. Ministério do Meio Ambiente, Brasília 177 p.
- Rios, E. C. 1994. Seashells of Brazil. Fundação Universidade do Rio Grande. Museu Oceanográfico, Rio Grande, RS. XII. P. 2: 368.

- Rocha, R. M.; Dias, G. M.; Lotufo, T. M. C. 2011. Checklist das ascídias (Tunicata, Ascidiacea) do Estado de São Paulo, Brasil. *Biota Neotrop* (Edição em Português. Online) 11 p.
- Santos, J. P.; Tenório, D. O.; Cantarelli, J. 2002a. Porifera (esponjas) do Estado de Pernambuco - Brasil. In: Tabarelli, M. & Silva, J. M. C. (Org.). *Diagnóstico da Biodiversidade de Pernambuco*. Recife - PE: Massangana 2: 385-404.
- Santos, J. P.; Tenório, D. O.; Cantarelli, J. 2002b. Atlas da Biodiversidade de Pernambuco. Recife: Secretaria de Ciencia Tecnologia e Meio Ambiente, (Atlas da Biodiversidade de Pernambuco).
- Santos, J.; Scherner, F.; Burgos, D. & Pereira, S. (2020). Avaliação Sazonal dos Impactos da Urbanização Costeira sobre Comunidades de Macroalgas na Costa de Pernambuco, Brasil. *Braz. J. of Dev.* 6. 42905-42938.
- Siebeck, U. E.; Marshall, N. J.; Kluter, A.; Hoegh-Guldberg, O. 2006. Monitoring coral bleaching using a colour reference card. *Coral Reefs* 25: 453-460.
- Silveira, L. F.; Beisiegel, B. M.; Curcio, F. F.; Valdujo, P. H.; Dixo, M.; Verdade, V. K.; Mattox, G. M. T. & Cunningham, P. T. M. 2010. Para que servem os inventários de fauna? *Estud Av*, 24, 68: 173-207.
- Smetacek, V. 1984. The supply of food to the benthos. In: Fashman, M. J. R. Eds. *Flows of energy and materials in marine ecosystem: theory and practice*. New York, NY: Plenum Press: pp. 517-547.
- Spalding, M. D. & Grenfell, A. M. 1997. New estimates of global and regional coral reef areas. *Coral Reefs* 16 4: 225-230.
- Spalding, M. D.; Burke, L.; Wood, S. A.; Ashpole, J.; Hutchison, J. & zu Ermgassen, S. E. (2017). Mapping the global value and distribution of coral reef tourism. *Marine Policy*. 82. 104-113. 10.1016/j.marpol.2017.05.014.
- Steiner, A. Q.; Eloy, C. C.; Amaral, J. R. B. C.; Amaral, F. M. D. & Sassi, R. 2006. O turismo em áreas de recifes de coral: considerações acerca da Área de Proteção Ambiental Costa dos Corais (Estados de Pernambuco e Alagoas). *OLAM – Ciênc Tecnol.*, Rio Claro 6 2: 281-296.
- Vasconcelos, B. A. 2018. Polyplacophora (Mollusca) nos Recifes Areníticos da Boca da Barra, Itamaracá -PE, Brasil. 35 f. Trabalho de Conclusão de Curso (Bacharelado em Ciências Biológicas) - Departamento de Biologia, Universidade Federal Rural de Pernambuco, Recife.
- Vieira, L. M. 2008. Sistemática e distribuição dos briozoários marinhos do litoral de Maceió, Alagoas. Dissertação (Mestrado em Ciências Biológicas (Zoologia) - Universidade de São Paulo.
- Vieira, L. M.; Migotto, A. E. & Winston, J. E. 2008. Synopsis and annotated checklist of Recent marine Bryozoa from Brazil. *Zootaxa* 18 10: 1-39.
- Young, P. S. 1988. Recent Cnidarian associated barnacles (Cirripedia, Balanomorpha) from the brazilian coast. *Rev Bras Zool*, 5 3: 353-369.