

Checklist of polychaetes (Annelida: Polychaeta) from a sandstone reef of Southeastern Brazil

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Abstract. A checklist of polychaetes from a neglected region of Brazil is presented. This is the first study conducted on the sandstone reef of the Urussuquara Beach in the Espírito Santo State, in Southeastern Brazil. The samplings occurred in the intertidal region by through of a quadrat of 30 cm x 30 cm. Among the 36 polychaete taxa found, the most abundant were *Phragmatopoma caudata*, *Marphysa sanguinea*, *Perinereis* spp., *Perinereis anderssoni*, and Syllidae type 1 and a zona lower intertidal presented larger abundance. Our study also contributes with new records of four polychaete genus for the Espírito Santo State, *Notomastus*, *Hemipodus*, *Lysarete*, *Proceraea* and a new species of Syllidae. We hope to promote a better understanding of the sandstone reef's biodiversity, fill the gap that exists in the Espírito Santo State and to contribute as a useful basis for the future elaboration of management and conservation plans for this environment.

Keywords: Consolidated substrate; Intertidal zone; Macrofauna; New records; Urussuquara Beach.

Resumo. *Checklist de poliquetas (Annelida: Polychaeta) de um recife de arenito do sudeste do Brasil.* Uma lista de verificação de poliquetas de uma região negligenciada do Brasil é apresentada. Este é o primeiro estudo realizado no recife de arenito da praia de Urussuquara, no estado do Espírito Santo, no sudeste do Brasil. As amostragens ocorreram na região intertidal por meio de um quadrat de 30 cm x 30 cm. Entre os 36 táxons encontrados, os mais abundantes foram: *Phragmatopoma caudata*, *Marphysa sanguinea*, *Perinereis* spp., *Perinereis anderssoni* e Syllidae tipo 1 e a zona intertidal inferior apresentou maior abundância. Nosso estudo também contribui com novos registros de quatro gêneros de poliquetas para o Estado do Espírito Santo, *Notomastus*, *Hemipodus*, *Lysarete*, *Proceraea*, bem como uma nova espécie de Syllidae. Esperamos promover uma

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melhor compreensão da biodiversidade dos recifes de arenito, preencher a lacuna que existe no Espírito Santo e contribuir com uma base útil para a elaboração futura de planos de manejo e conservação para este ambiente.

Palavras-chave: Substrato consolidado; Zona intertidal; Macrofauna; Novos registros; Praia de Urussuquara.

Introduction

Polychaeta is a predominantly marine group whose main characteristic are their numerous bristles distributed by the body emerging from fleshy projections named parapodia. This group presents a high taxonomic diversity, a broad morphological variety, and several feeding strategies, including predation, parasitism, suspension feeding, and debris ingestion (Rouse and Pleijel, 2001). These worms can be pelagic, epibenthic or diggers, occur from the intertidal region to the deep sea, and are found in all regions of the planet, from tropical to polar regions (Rouse and Pleijel, 2001, D'Alessandro et al., 2016). They represent an important group in reef environments and present different lifestyles, can be sessile or free living and inhabit virtually all types of substrate, including unconsolidated sediments such as sand and mud, and consolidated, such as rocky shores and sandstone reefs.

Sandstone reefs are limestone formations resulting from the consolidation of ancient beaches, or from one or more banks of consolidated sand (Correia, 2005). These formations consist of rectilinear rock structures, which are parallel to the coastline and can be uncovered at low tides (Correia and Sovierzoski, 2009). Differ from a typical rocky shore and coral reefs mainly because of their gentle slope and sedimentary composition (Rabelo et al., 2015). These consolidated substrates are formed by the sedimentation of ancient Quaternary sandbanks through chemical reactions with calcium carbonate and are usually arranged along parallel lines to the coast and near the mouths of rivers and estuaries (Correia and Sovierzoski,

2009; Correia, 2010; Padula et al., 2012). Often, these reefs are responsible for the stability of many coastal regions, since they are located in intertidal regions or permanently flooded areas, acting as wave energy sinks, protecting coves, and sometimes forming natural pools (Maia and Cavalcante, 2005).

Likewise rocky shores, sandstone reefs are dynamic habitats and harbor a wide variety of macrofauna, meiofauna and benthic organisms, including benthic algae (Giere, 2009; Sönmez et al., 2014). Also, sandstone reefs provide food and shelter for these organisms and allow their growth and reproduction (Nybakken and Bertness, 2004).

Many of the animals found in this environment live intertwined with marine algae adhered to the substrate, thus constituting the phytal. The algae increase the complexity of the environment and amount of resources for organisms. They also provide a substrate for flora and fauna, thus favoring a milder environment against the action of waves. Thus, the algae contribute to the development of different life forms, consequently raising the biodiversity of the environment (Edgar, 1983; Masunari, 1987; Gao and McKinley, 1994; Spalding et al., 2003; Nascimento and Rosso, 2007).

In Brazil, most of the studies on fauna associated to algae were performed on rocky shores, since these environments are distributed along almost the entire coast, particularly in Southeastern Brazil (Coutinho, 2002). On the other hand, surveys on the benthic fauna of consolidated substrates in the Brazilian coast are still scarce (Coutinho, 2002), including the marine invertebrates of the Espírito Santo State

in southeastern Brazil, among which species of the Phylum Annelida stand out.

Regarding the marine benthic macrofauna in Brazil, the coasts of the Southern and Southeastern have been the most studied regions, except for the Espírito Santo State in the Southeast (Amaral and Jablonki, 2005). Particularly for Espírito Santo State, most of the few studies conducted so far on its coast are concentrated in the Central and Southern Mesoregions (Nalesso et al., 2005; Costa and Nalesso, 2006; Sá et al., 2007). In the Northern Mesoregion of the Espírito Santo State, although some studies involving benthic macrofauna have been conducted (Scamparile, personal observation), none of them has been published yet.

In this paper, we present the checklist of Polychaeta of Urussuquara sandstone reef and their distribution between three intertidal zones. We emphasize the need to know what is in this ecosystem since studies on sandstone reefs are neglected in relation to other consolidated substrates. Another factor that justifies this work is the construction of the São Mateus Port Center planned for the beginning of 2019, which may extinguish the local fauna causing changes in the fauna of Urussuquara Beach and its surroundings. We hope to promote a better understanding of the sandstone reef's biodiversity, as well as to contribute as a useful basis for the future elaboration of management and conservation plans for this environment.

Materials and methods

Study area and field sampling

The study was conducted on a sandstone reef in the Urussuquara Beach (19° 04' 09" S, 39° 43' 22" W), Northern Espírito Santo, Southeastern Brazil, in an area near the mouth of the Ipiranga River, which runs in parallel with the sea (Figure 1). In this place, next year will be installed a port terminal that will bury the reef.

Sampling was performed during low tides on spring tides on August 2010, February 2011, and August 2011. Per sampling period, six replicates were collected in each zone of the intertidal region (lower intertidal, LI; middle intertidal, MI; and upper intertidal, UI). Quadrats (30 cm x 30 cm) were randomly thrown on algae stains present on the substrate and, from this delimitation, the algae were scraped with a metal spatula.

The collected material was stored in plastic bags, labeled, and fixed in 10% formaldehyde. Subsequently, the material was taken to the Benthic Ecology Laboratory, University Center of Northern Espírito Santo, Federal University of Espírito Santo (CEUNES/UFES), where it was washed in a 500 µm sieve. After this procedure, the samples were sorted in a stereomicroscope (Leica EZ4), and the polychaetes were separated and preserved in 70% alcohol. Taxonomic identification was based on the morphological characters visualized using an optical microscope (Olympus CX31).

Samplings were realized under license granted by the Biodiversity Information and Authorization System (SISBio No. 23658-1), issued by Ministry

of Environment (MMA), Chico Mendes Institute for Biodiversity Conservation (ICMBio).

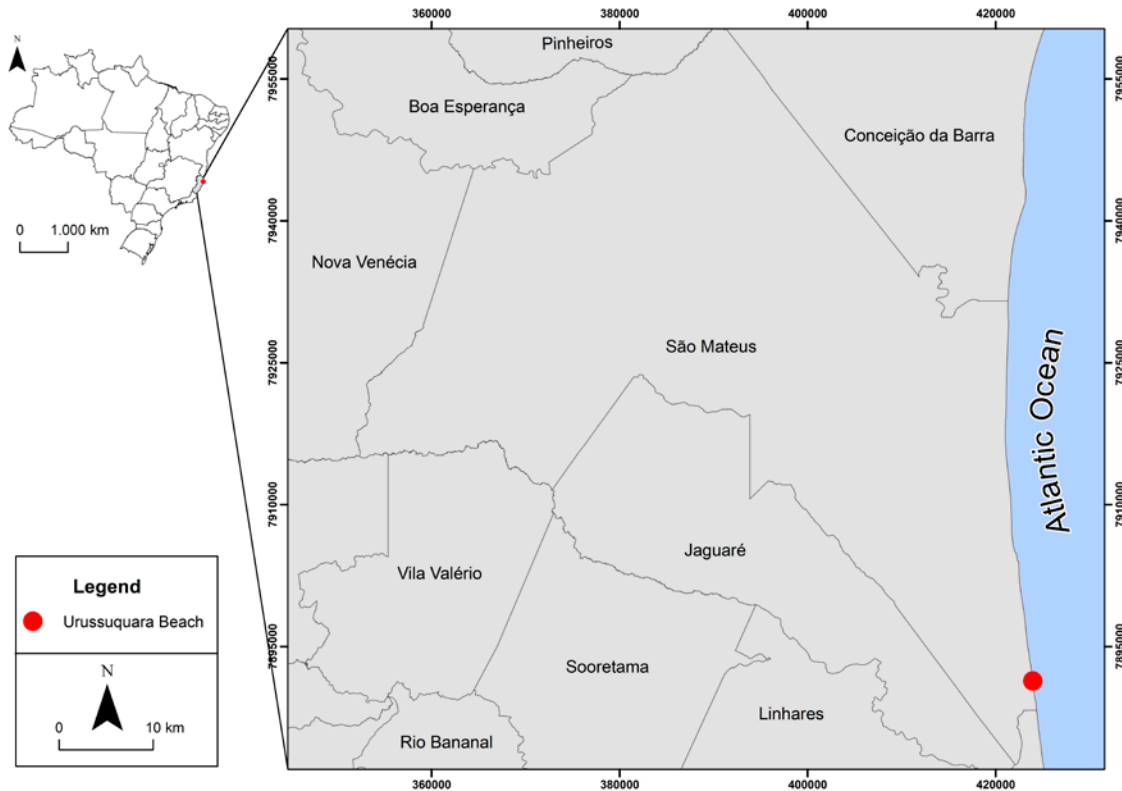


Figure 1. Map of the study area in Espírito Santo State, Southeastern Brazil. Polychaetes were collected at a sandstone reef in the Urussuquara Beach.

Results

We sampled a total of 1,395 individuals (Table 1) distributed in 36 taxa, of which the most abundant were *Phragmatopoma caudata* (Sabellariidae) (31%), followed by *Marphysa sanguinea* (Eunicidae) (16%), *Perinereis anderssoni* (Nereididae) (8%), *Perinereis* spp. (Nereididae) (8%), Syllidae type 1 (7%), and *Alitta succinea* (Nereididae) (6%).

The other 30 taxa found were very low in abundance (below 5% each). In the three months of sampling, the lower intertidal always presented the greatest abundance of species. Our study also contributes with new records of four genus for the Espírito Santo State, *Notomastus*, *Hemipodus*, *Lysarete*, *Proceraea* and a new species of Syllidae, which is currently under description.

Table 1. Taxa found in the middle intertidal region of sandstone reef in the Urussuquara Beach.

Taxon	August/2010			February/2011			August/2011		
	UI	MI	LI	UI	MI	LI	UI	MI	LI
Capitellidae Grube, 1862									
<i>Capitella</i> sp. Blainville, 1828	1	5	0	4	8	2	1	0	1
<i>Notomastus</i> sp. M. Sars, 1851*	0	0	0	0	0	0	1	0	1
Eunicidae Berthold, 1827									
<i>Eunice</i> sp. Cuvier, 1817	0	0	0	0	0	0	0	3	0
<i>Lysidice</i> sp. Lamarck, 1818	0	0	2	1	0	1	1	0	0
<i>Marphysa sanguinea</i> Quatrafages, 1866	29	39	1	32	68	6	35	9	6
Glyceridae Grube, 1850									
<i>Hemipodus</i> sp. Quatrafages, 1866*	0	0	0	0	0	0	0	1	0
Goniadidae Kinberg, 1866									
Undetermined Goniadidae	0	1	1	0	0	0	0	0	0
Nerididae Blainville, 1818									
Undetermined Nereidae	2	3	0	0	2	0	1	0	1
<i>Laeonereis culveri</i> (Webster, 1879)	0	0	0	0	0	0	0	0	2
<i>Neanthes</i> sp. (Leuckart, 1847)	0	0	0	0	0	0	0	0	8
<i>Alitta succinea</i> (Leuckart, 1847)	1	3	2	24	8	41	2	3	6
<i>Nereis</i> sp. Linnaeus, 1758	0	0	0	0	0	0	0	0	5
<i>Nereis broa</i> Lana and Sovierzovsky, 1987	0	1	3	0	0	0	0	1	2
<i>Nereis riisei</i> Nereis, 1857	2	0	0	0	0	0	0	3	6
<i>Perinereis</i> spp. (Grube, 1840)	4	10	0	19	56	19	0	2	0
<i>Perinereis anderssoni</i> Kinberg, 1866	2	7	18	3	9	6	21	2	44
<i>Perinereis cultrifera</i> (Grube, 1840)	0	0	0	0		2	0	0	3
<i>Perinereis ponteni</i> Kinberg, 1866	7	2	0	2	4	56	0	0	5
Lumbrineridae Schamarda, 1861									
<i>Lysarete</i> sp. Kinberg, 1865*	9	0	0	0	0	0	0	0	0
Sabellariidae Johnston, 1865									
<i>Phragmatopoma caudata</i> Krøyer in Mörch, 1846	5	14	17	6	302	78	0	0	7
Terebellidae Johnston, 1846									
Undetermined Terebellidae	18	1	0	0	0	0	0	0	0
Syllidae Grube, 1850									
<i>Proceræa</i> spp. Langerhans, 1884*	1	0	0	0	0	0	0	0	0
<i>Syllis</i> cf. <i>magellanica</i> Augener, 1918	13	16	0	0	22	0	21	0	2
<i>Syllis pseudoarmillaris</i> Nogueira and San Martin, 2002	6	0	0	0	0	0	9	0	0
<i>Syllis</i> sp. 2 Savigny in Lamarck, 1818	0	0	1	0	0	0	0	0	2
<i>Syllidae</i> Type 1	6	46	3	15	15	4	2	5	2
<i>Syllidae</i> Type 2	16	0	0	15	0	0	0	1	0
<i>Syllidae</i> Type 3	0	1	0	0	0	0	0	0	0
<i>Syllidae</i> Type 4	0	0	0	0	0	19	0	0	0
Sipuncula Stephen and Edmond (1972)	3	0	0	0	3	0	2	0	0

UI = upper intertidal; LI = lower intertidal; MI = middle intertidal. (*) Indicate new records for the Espírito Santo State, Southeastern Brazil.

Discussion

The most abundant species of this study are common to other studies on consolidated substrates (Amaral et al., 2013). For example, *Phragmatopoma caudata* (the most abundant), is a gregarious Sabellaridae ecologically relevant in the construction of biogenic reefs that contribute to increase diversity and protect coasts (Goldberg, 2013; Nunes et al., 2017). In Brazil, there are records of *Phragmatopoma caudata* along the coast, from the Piauí State in the Northeast (Gomes-Filho et al., 2017) to the Rio Grande do Sul State in the South of the country (Kirtley, 1994; Lana and Bremec, 1994; Pagliosa et al., 2014).

The second most abundant species, *Marphysa sanguinea*, is a common eunicid, globally distributed on consolidated and unconsolidated substrates of different marine environments, especially in sheltered places (Li et al., 2014). Species of Eunicidae are commercially used in aquaculture as food for fishes and shrimps (Fidalgo e Costa et al., 2016) and as bait in recreational fishing (Zanol et al., 2016).

Regarding species of Nereididae, *Perinereis anderssoni* and other species of the genus *Perinereis* are widely distributed along the Western Atlantic, occurring mainly on rocky shores (Santos and Steiner, 2006; Peixoto and Santos, 2016). *Perinereis* spp. and *Alitta succinea* can be easily found in shallow waters (Coutinho and Santos, 2014).

Species of Syllidae are very abundant and diverse in benthic marine habitats and are especially common on hard substrates, where they display an erratic lifestyle between algae and rock crevices. The taxonomic identification at a specific level can be hampered by the small size of the individuals and by the absence of studies with taxonomic keys

and detailed descriptions (San Martín and Worsfold, 2015). Both Nereididae and Syllidae are families of common predatory species in the intertidal (Barroso et al., 2017; Chatzigeorgiou et al., 2017).

This study consists of the first inventory of polychaetes of the Urussuquara Beach and represents the first step to fill the knowledge gap on sandstone reefs in Southeastern Brazil and on the Espírito Santo State. Our work records for the first time the genus *Notomastus* (Capitellidae), *Hemipodus* (Glyceridae), *Lysarete* (Lumbrineridae), *Proceraea* (Syllidae) and a new species of Syllidae that is currently under description (Paresque et al., in prep.) (Table 1).

In addition, it is worth mentioning that the environment studied here may suffer eminent extinctions, since it is planned for January 2019 to build a large development of Odebrecht and Petrocity Portos, the São Mateus Port Center. The impacts caused by such a large building reinforce that environmental degradation remains the greatest threat to coastal and marine regions and that the biodiversity crisis is widespread because species are being extinguished at a rate higher than described. Studies such as this one are relevant efforts to prevent or draw attention to it.

Conclusions

This work contributes to the dissemination of the diversity of Espírito Santo State polychaetes, registering four new genus for the state and providing the first inventory for Urussuquara Beach, a place that will suffer from the impacts of the construction of a Port next year. We hope that this work will contribute as a useful basis for the future elaboration of management and conservation plans for this environment.

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Conflict of interests

The authors declare that they have no conflict of interests.

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