

The distribution of macrofauna on the inner continental shelf of southeastern Brazil: The major influence of an estuarine system



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ABSTRACT

The environmental heterogeneity of the Campos Basin on the northern coast of Rio de Janeiro State was assessed by the benthic macrofauna on the platform adjacent to the Paraíba do Sul River (PSR) on the dry and rainy seasons. The samples were collected in triplicate from 33 sites using a van Veen grab during March 2009 – a period of higher precipitation and flow rate – and July 2009 – a period of lower precipitation and flow rate. The grab depths ranged from 12 to 97 m and were grouped into three strata: 1: <25 m, 2: 25–50 m and 3: >50 m. The particle size, total carbonate and total organic carbon in each sample were analyzed. Subsamples for the macrofauna analysis were washed, sieved with a 500 µm mesh and identified. The sediment was predominantly composed of sand, with mud pockets near the mouth of the river. The macrofauna included annelids, crustaceans, mollusks, echinoderms, cnidarians, nemerteans, cephalochordates, sipunculids and bryozoans. The density and richness were directly related to the depth, with both descriptors being higher during the rainy season and at depths greater than 50 m. This result is probably due to the higher availability of food in the river during this period and is corroborated by the predominance of deposit feeders in the deepest stratum. The number of individuals of each species was higher in the shallowest stratum, probably due to the higher productivity of this stratum. The rate of organic particulate matter flow from the coastal regions to the deeper regions can also be influenced by the material export dynamics of the river, which are more intense during the rainy season. These dynamics explain why a significantly higher number of individuals were observed in the rainy period in comparison to the dry one. Multivariate analyses identified differences between the sampling sites in the deepest stratum during both periods and revealed a stronger similarity between the shallow and intermediate strata, especially during the rainy season, which has a higher flow rate. These findings reinforce the influence of the Paraíba do Sul River on the structural pattern and composition of the benthic macrofauna of the internal platform (<50 m) on the northern coast of Rio de Janeiro.

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1. Introduction

Benthic macrofauna play an important role in the physical structure of their habitats (Thrush and Dayton, 2002). By excavating the substrate and building tubes, they change the circulation of the water, participate in sediment aeration, modify the pattern of sedimentation and create microhabitats (Gray, 1981; Pereira and Soares-Gomes, 2009). By feeding, macrofauna convert particulate organic matter into animal biomass and reprocess deposited

particles (Amaral and Migotto, 1980; McCall and Tevesz, 1982; Kawakami and Amaral, 1983; Gray and Elliot, 2009).

The occurrence and distribution of macrofaunal organisms are often correlated with the predominant environmental characteristics of the ecosystem (Zajac and Whitlatch, 1982). Hydrodynamics and sediment characteristics like grain size, organic matter and carbonate content, have repeatedly been referred to as factors that contribute to the variability of soft-bottom communities (Snelgrove and Butman, 1994), which are influenced by the ability of the bottom currents to favor sedimentation and/or resuspension and sediment transport, particularly in shallow waters (Sternberg, 1984). In addition to sedimentation features, the availability of food and the physicochemical characteristics of the water such as

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salinity, oxygen content and temperature directly influence the richness and abundance of the macrofauna (Gray, 1974, 1981; Lenihan and Micheli, 2001).

Tropical continental margins are of particular relevance, because they receive the majority of global riverine water and sediment inputs (in Jennerjahn et al., 2010) The Paraíba do Sul River (PSR) plays an important role in the ecosystem of the north continental shelf of Rio de Janeiro State, with the export dynamics of dissolved and particulate materials correlated to the rainfall and flow rate (Souza and Knoppers, 2003; Figueiredo, 2011). This river is a multiple source system derived from its land use (urban, industrialization and agriculture) and over the last five decades the continuous sewage outflow in all basis (180 municipalities have ~50% of sewage treatment), industrial spills (Hoag, 2003) and agriculture (Dittmar et al., 2012) have promoted several disruptions in the structure and functioning into the aquatic ecosystem. All these transformations together will certainly compromise the coastal region considering that the latter authors have identified an outwelling at least of 20 km and a mixture rate of 1.6–2.6 km d⁻¹ (Souza et al., 2010). The Paraíba do Sul River seasonal discharge

exhibits a dry period between the months of May and September and a rainy one from October to April (Carvalho et al., 2002). The temporal variations in the flow rate induce variations on the coastal water's salinity and temperature (Rudorff et al., 2011), in the concentrations of nutrients (Gatts et al., 2005) and pollutants and on the export (Lacerda et al., 1993) and sediment dynamics (Ribeiro et al., 2004).

The present study aimed to evaluate the effect of the flow rate of the Paraíba do Sul River on the benthic macrofauna of the inner river platform (<50 m), where different discharge periods of the river and rainfall are well defined. We tested the hypotheses that spatial variations on the structure and composition of the macrofauna respond to the sedimentary variations that result from hydrodynamic processes on the inner platform adjacent to the Paraíba do Sul River.

2. Study site

The study area is located at 21°36'S, 41°00'W, on the continental shelf north of the Rio de Janeiro State, and it is adjacent to the

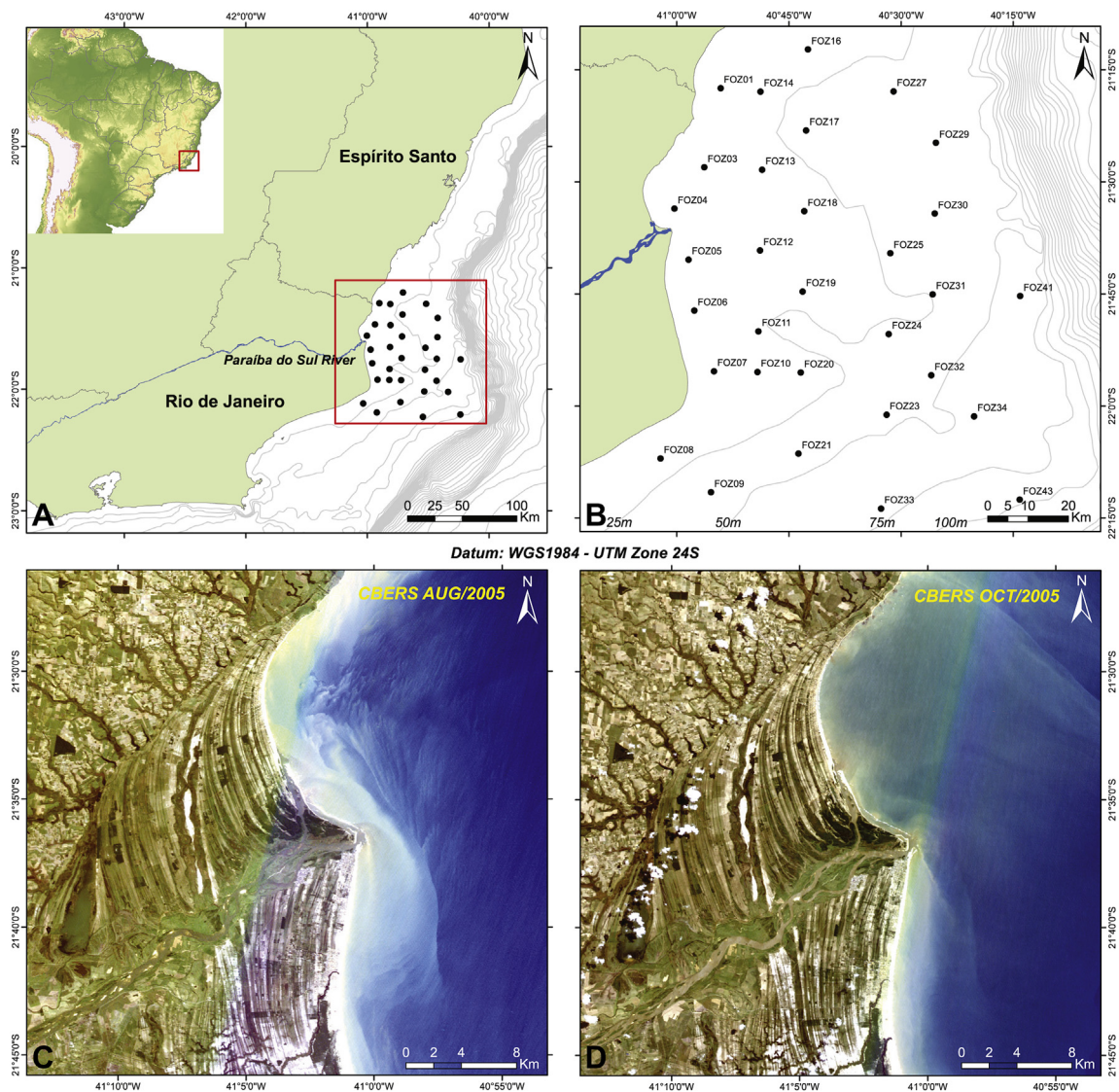


Fig. 1. A) The study area on the northern coast of the State of Rio de Janeiro. B) A map showing the locations and depths of the sampling sites at the mouth of the Paraíba do Sul river. C) The plume of the Paraíba do Sul river (PSR) identified using satellite images during the period with the lowest flow rate and (D) during the period of greatest flow rate.

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