Intertidal sandy beaches Polychaetes of São Sebastião island, southern Brazil

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ABSTRACT

The composition and distribution of polychaete fauna along sandy beaches of São Sebastião Island (southern Brazil) and their relation with sediment variables were examined. Functional feeding groups were used to investigate distribution patterns of intertidal polychaetes. The beaches were dominated by detritivores. Surface-deposit feeders and suspension-feeders presented higher relative abundances in very fine sand, whereas carnivorous polychaetes and subsurface-deposit feeders were more abundant in coarser sands. The proportion of subsurface-deposit feeders increased in medium sediments with higher percentages of organic carbon. Sessile polychaetes generally inhabited physically stable habitats, and occurred in low proportion. The distribution and abundance of feeding groups seem to be related to sedimentary conditions and environmental stability.

RÉSUMÉ

Polychètes intertidaux des plages sableuses de l'île de São Sebastião, Brésil méridional

La composition et la distribution de la faune de polychètes ont été examinées de long des plages sablonneuses de l'Ile de São Sebastião (Brésil méridional) en relation avec les caractéristiques sédimentaires. Les modèles de distribution des polychètes intertidaux ont été recherchés en utilisant les groupements fonctionnels alimentaires. La distribution et l'abondance selon les groupes trophiques paraissent en relation avec les conditions sédimentaires et la stabilité du milieu. Il a été observé que 1) les espèces détritivores sont numériquement dominantes dans les groupements macrobenthiques, la classe trophique des détritivores de surface étant la plus abondante ; 2) la proportion de ces derniers et des suspensivores peu mobiles atteint son maximum dans le sable très fin, tandis que les espèces carnivores ont leur plus grande abondance dans les sables grossiers ; 3) les détritivores de subsurface sont dominants dans la plupart des habitats et leur abondance croît dans les sédiments moyens avec les taux le plus élevés de carbone organique ; 4) les espèces sessiles se rencontrent généralement dans les habitats physiquement stables.

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INTRODUCTION

Sediment structure is an important factor determining organization of soft-bottom benthic communities. The inter-relationships of habitat, resource availability, and feeding mechanisms are fundamental aspects of the animal-sediment interactions. In this regard, trophic group analysis can play a significant role in the determination of distribution patterns and benthic community organization (SANDERS, 1958; LEVINTON, 1972; WHITLATCH, 1980, 1981).

Polychaetes have a relevant participation in the productivity of marine ecosystems. They present high levels of trophic functional diversity (FAUCHALD & JUMARS, 1979) allowing their application on the determination of soft-bottom communities trophic structure (MAURER & LEATHEM, 1981; BIANCHI & MORRI, 1985; PAIVA, 1990). However, information on polychaete feeding biology and trophic-group interactions is limited for the intertidal system.

The purpose of this study was to define the polychaete fauna composition and to examine aspects such as feeding biology and trophic structure of the macrobenthic species along beaches of São Sebastião Island. Sediment attributes of the intertidal region, i.e., granulometry and organic-matter content were also studied and used to interpret the spatial patterns of polychaete trophic-groups. Species distribution patterns and polychaete community structure of these beaches were described by AMARAL *et al.* (in press).

MATERIAL AND METHODS

The polychaete fauna of 12 beaches on the innerside of São Sebastião Island, southeastern Brazilian coast (23°44' to 23°52'S - 45°21' to 45°26'W), was examined between May 1990 and March 1991. The island is separated from the mainland by a deep channel (Fig. 1). Many contiguous protected beaches are present on the north side. The intertidal zone is usually relatively narrow, but may increase in size because of sand or boulder barriers covered with the angiosperm *Halodule*. The central part of the island is a typical low energy environment with a wide intertidal zone and gently sloping gradients. Small narrow beaches with steep slopes characterize the exposed southern coast.

Eighty two biological samples were taken from the intertidal region. The macrofauna was collected from within a rectangular iron sampler of 0.025 m^2 and 10 cm depth. Two replicates were taken at each station. The sediment was washed through sieves of 1.0 and 0.5 mm mesh. The organisms retained were preserved in 70 % alcohol for later identification. Parallel sediment samples were taken. These were dry sieved for granulometric analyses (SUGUIO, 1973). The organic matter content was determined by calcination (AMOUREUX, 1966).

All polychaetes present were classified according to trophic categories proposed by FAUCHALD & JUMARS (1979). Each species was allocated to one of these classes on the basis of their gut-contents and previous studies. Since beach sediments are continuously ressuspended by wave action, the detritivores were subdivided into surface, subsurface and suspension feeders. Some species were assigned to more than one trophic group because they have alternative feeding mechanisms.

RESULTS

Polychaetes were absent from the samples taken from the southern and northern exposed beaches. A total of 1765 individuals in 38 species were present in the samples from seven beaches.

The beaches of Barra Velha, Perequê, Engenho d'Água, Fora and Siriuba had a largest number of species and specimens (Table 1). The greatest polychaete densities (ind. 0.05 m^{-2}) were *Scolelepis squamata* (304) at Siriuba ; *Heteromastus filiformis* (96), *Capitella capitata* (66), *Laeonereis acuta* (64), and *Isolda pulchella* (33) at Barra Velha ; *Scoloplos* (*Leodomas*) sp. (22), and *Owenia fusiformis* (16) at Fora, and *Armandia agilis* (15) at Perequê.

Detritivores numerically dominated the polychaete fauna, comprising 96 % of the individuals. Surface deposit-feeders, primarily represented by *S. squamata*, *C. capitata*, and *I. pulchella*, were the most abundant feeding group throughout the area (39.1 %) (Fig. 2). Subsurface deposit-feeders (36.2 %) dominated the central part of the island (Barra Velha) which had the highest concentration of organic matter (Table 1). *L. acuta*, *S.* (*Leodamas*) sp. and *H. filiformis* were the most abundant of the 10 species present. The proportion of suspension feeders was low in most beaches and increased at Siriuba and Garapocaia (Fig. 2) due to abundance of *S. squamata*. Carnivores were the less abundant feeding group (4.2 %) and were mainly represented by *Langerhansia cornuta*, *Marphysa sanguinea*

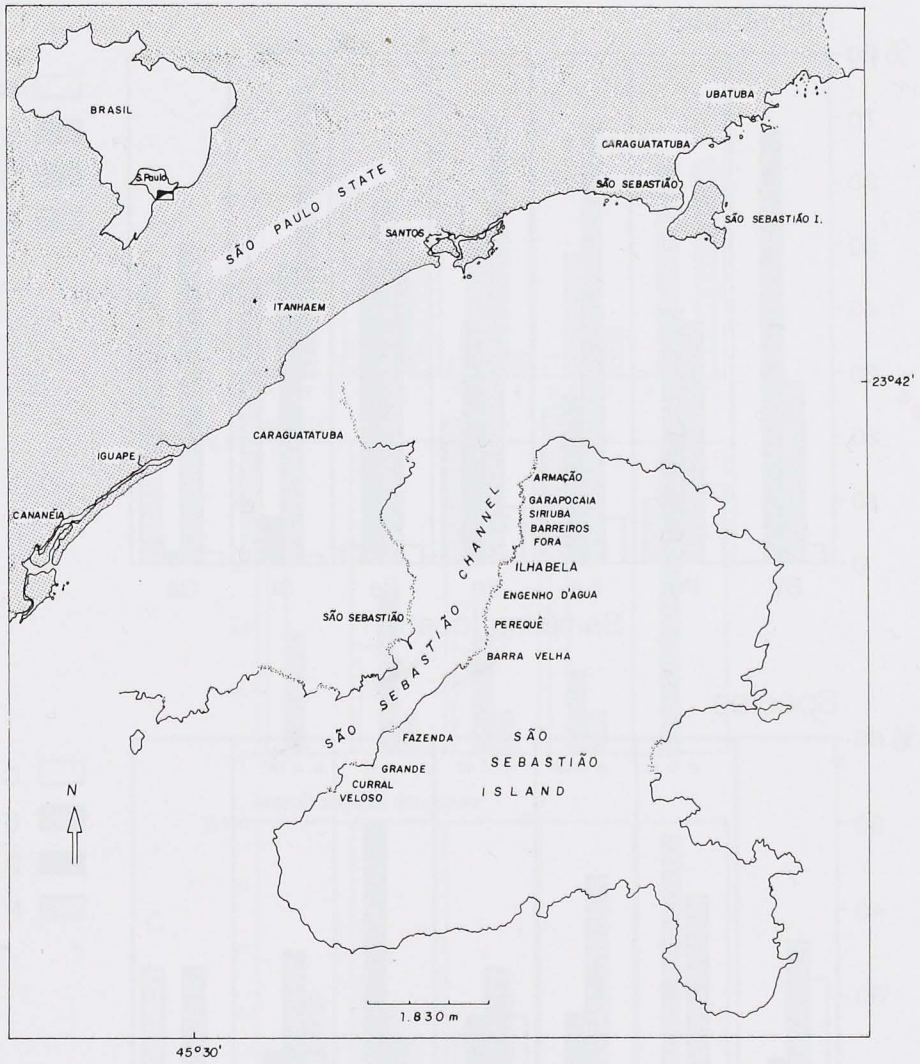

FIG. 1. — Location of the station locations at São Sebastião Island.

and *Lumbrinereis tetraura*. The number of carnivores was greatest in very coarse sand at Perequê, Engenho D'Água and Fora.

The most abundant and diverse polychaete fauna occurred in medium sands (Fig. 3). Mobile subsurface deposit-feeders and carnivores were dominant in coarse grains. On the other hand, surface deposit-feeders and suspension feeders were rare or absent in coarser grains and increased in numbers in fine sands.

Motile polychaetes were common in coarse and medium sediments, while discretely motile ones preferred very fine sand. Sessile polychaetes, although more abundant in medium grains, were present in low proportions (< 20 %) in all substrates.

Jawed forms were rare, whereas soft-proboscis species occurred in high proportions (> 30 %) in all sediments, except in very fine sand. Tentaculate species dominated in fine sands (96 %) as surface detritivores and suspension-feeders.

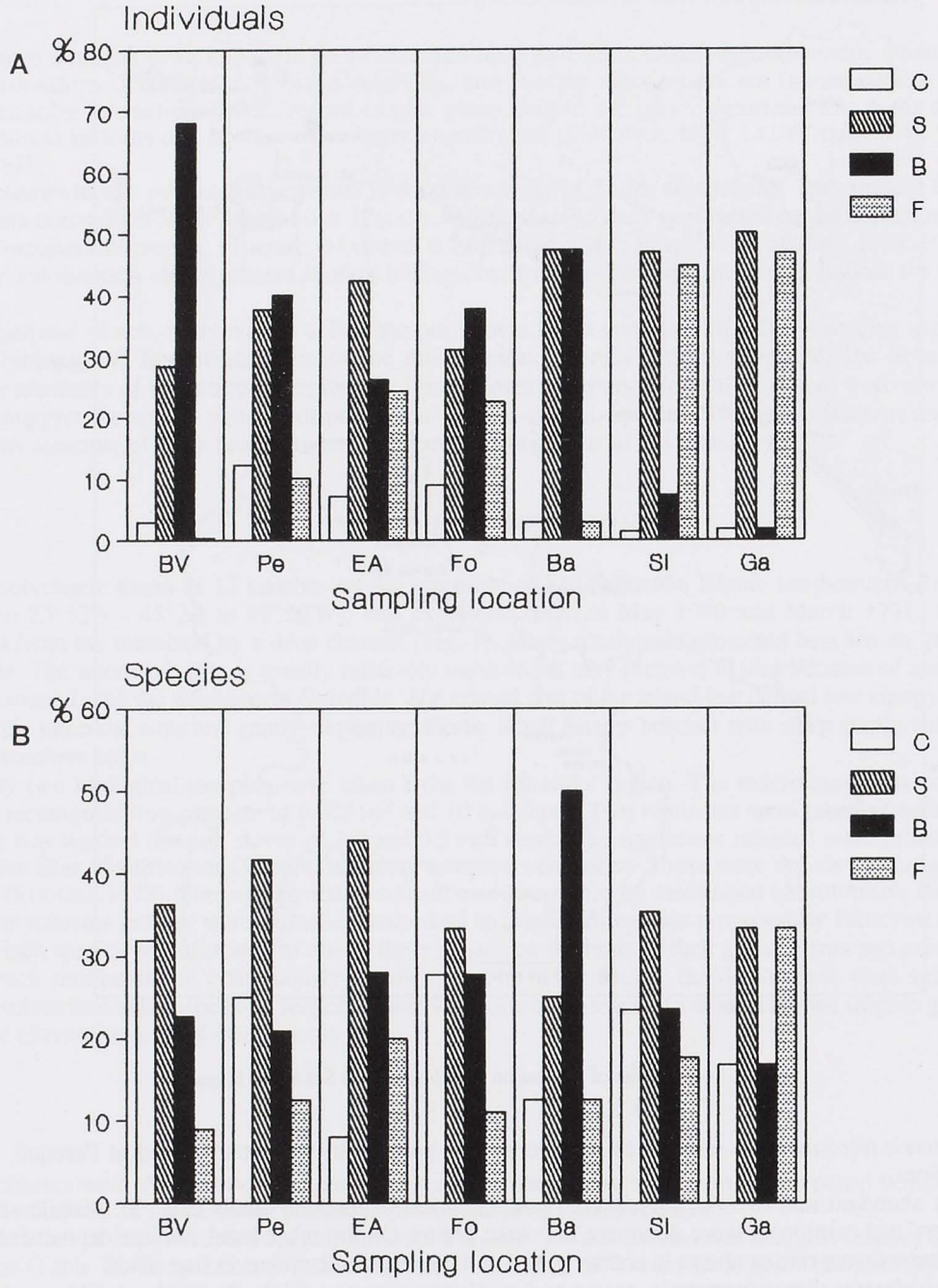

FIG. 2. — Trophic groups distribution (A= individuals and B= species, in percentage) at different sampling locations: Barra Velha (BV); Perequê (Pe); Engenho D'Água (EA); Fora (Fo); Barreiros (Ba); Siriúba (Si); Garapocaia (Ga). Carnivore (C); Surface deposit-feeders (S); Subsurface deposit-feeders (B); Suspension-feeders (F).

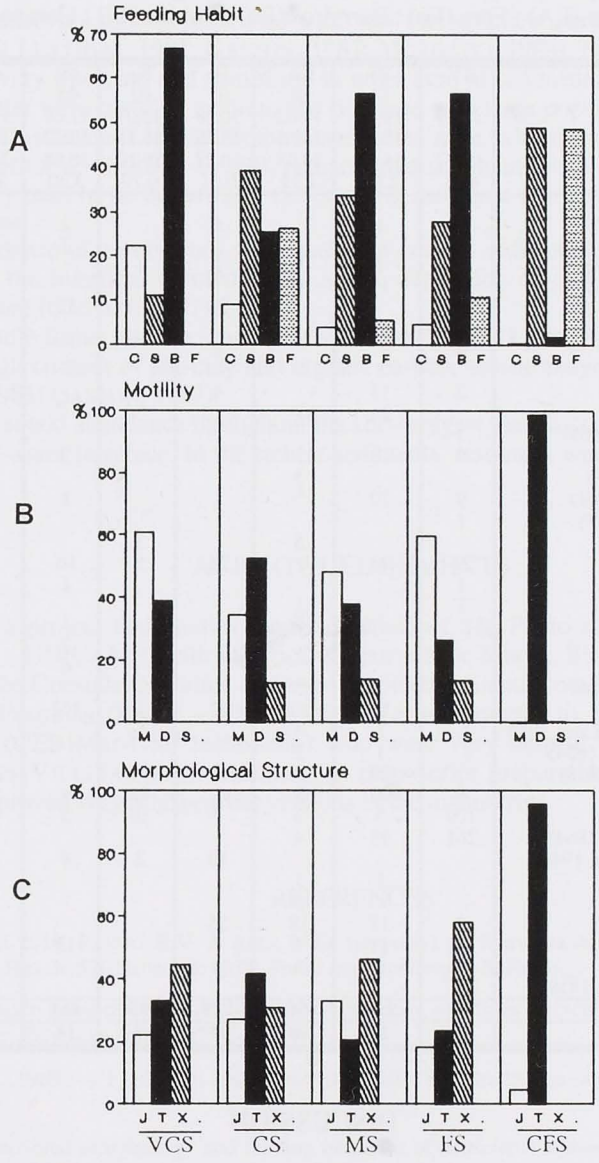

FIG. 3. — Individual percentages of feeding habitats (A), motility (B) and morphological structure (C), in granulometric classes. Categories: Carnivore (C); Surface deposit-feeders (S); Subsurface deposit-feeders (B); suspension-feeders (F); Motile (M); Discretely motile (D); Sessile (S); Jawed (J); Tentaculate (T); Other structures (X). (VCS: very coarse sand; CS: coarse sand; MS: medium sand; FS: fine sand; CFS: very fine sand).

TABLE 1. — Sediment average physico-chemical parameters, and polychaete species occurrence, total number of individuals and functional trophic groups (FTG), at different sampling site: Barra Velha (BV) ; Perequê (Pe) ; Engenho D'Água (EA) ; Fora (Fo) ; Barreiros (Ba) ; Siriúba (Si) ; Garapocaia (Ga).

SAMPLING LOCATIONS	BV	Pe	EA	Fo	Ba	Si	Ga		
SAMPLING NUMBERS	17	14	08	07	02	08	06		
coarse	18.10	19.22	13.62	30.38	12.07	11.64	17.65		
SAND (%) medium	15.82	15.51	16.66	18.76	16.73	10.12	16.85		
fine	19.27	16.06	34.98	10.27	39.10	30.68	29.23		
ORGANIC MATTER (%)	4.71	2.64	1.33	0.61	0.70	3.30	2.30	TOTAL	FTG
Podarke pallida (Claparède, 1864)	1							1	CMJ
Loandalia americana Hartman, 1947	1	1		4		2		8	CMJ
Sigambra grubii O.F. Müller, 1858	1					3	1	5	CMJ
Langerhansia cornuta (Rathke, 1843)		7	5	1	1			14	CMJ
Ceratonereis mirabilis Kinberg, 1866		11	4					15	BDJ
Laeonereis acuta (Webster, 1879)	233			26		32		291	BDJ
Glycera americana Leidy, 1855	1	1						2	CDJ
Glycinde multidens Müller, 1858	4			2				6	CDJ
Goniada littorea Hartman, 1950		3						3	CDJ
Diopatra cuprea (Bosc, 1802)	2	11		4				17	SDJ
Diopatra ornata Moore, 1911		26	7					33	SDJ
Diopatra splendidissima Kinberg, 1865	3							3	SDJ
Marphysa sanguinea Nonato, 1965	5	13		7		5		30	CDJ
Nematonereis hebes (Montagu, 1815)			3					3	CDJ
Lumbrineris tetraura (Schmarda, 1861)	9	10		1		1		21	CMJ
Haploscoloplos fragilis (Verrill, 1873)	1							1	BMX
Naineris setosa (Verrill, 1900)			5	1	3			9	BMX
Scoloplos (*Leodamas*) sp.	24	44	1	24	1	16		110	BMX
Aricidea fragilis Webster, 1879	1					1		2	SMX
Dispio remanei Friedrich, 1956	1		1					2	SDT/FDT
Laonice branchiata Nonato, 1981			1					1	SDT/FDT
Polydora websteri Hartman, 1943						2		2	SDT/FDT
Prionospio dayi (Foster, 1969)						6		6	SDT/FDT
Prionospio steenstrupi Malmgren, 1867			5					5	SDT/FDT
Scolelepis squamata (Müller, 1806)		15		12	1	362	28	41	SDT/FST
Magelona variolamellata Bolivar e Lana, 1986		3	4					7	SDT
Chaetopterus variopedatus (Renier, 1804)		1	2					3	SDT/FST
Cirriformia tentaculata (Montagu, 1808)		20	2					22	SMT
Armandia agilis (Andrews, 1891)	6	26	9	1	11	9		62	BMX
Capitella capitata (Fabricius, 1780)	109	5	3	2	16	5	2	142	SMX
Heteromastus filiformis (Claparède, 1864)	261	33	4				1	299	BMX
Mediomastus californiensis Hartman, 1944				10	2	4		16	BMX
Nonatus longilineus Amaral, 1980		1	1					2	BMX
Notomastus lobatus Hartman, 1947			5					5	BMX
Owenia fusiformis delle Chiaje, 1841	2	13	18	25				58	SDT/FST
Isolda pulchella F. Müller, 1858	101	11	1	4		13		130	SST
Loimia medusa (Savigny, 1818)		3	3	4				10	SST
Terebellides anguicomus (F. Müller, 1858)	1							1	SST
TOTAL OF INDIVIDUALS	**767**	**258**	**84**	**128**	**35**	**461**	**32**	**1765**	
SPECIES NUMBER/LOCATION	**20**	**21**	**20**	**16**	**7**	**14**	**4**	**38**	

DISCUSSION

Low-density polychaete assemblages characterized the area. In physically stressed environments, such as the intertidal sandy beaches, dense assemblages seldom, if ever, develop. In this situation recruitment and abiotic factors such as turbulence tend to maintain population densities at low-levels (WILSON, 1984). On the other hand, in physically stable habitats, population densities increase, so that competition and predation regulate community structure (PETERSON, 1979). Habitat differences in sediment structure related to local hydrological conditions determined the distribution of trophic groups and consequently the community structure. Similar observations were reported by GASTON & NASCI (1988), and GASTON *et al.* (1988) in estuaries in Louisiana.

Surface deposit-feeders dominated most beaches because they can explore a wider resource spectrum in the sediment/water interface (EAGLE & HARDIMAN, 1977; JOSEFSON, 1986). Species which are able to use alternative strategies, such as Oweniidae and Spionidae (either surface-deposit feeders or suspension feeders), are able to occupy rich organic sediments as well as sediments with large amounts of suspended material.*Scolelepis squamata*, the most abundant spionid, presents morphological and ethological adaptations which allow its survival in harsh environments. Unlike other spionids it has permanent palps, allowing the occupation of sand habitats

where deciduous palps are easily lost by the action of turbulence and where predation rates are low (DAUER, 1983).

Subsurface-deposit feeders are usually associated with very fine sediment particles and rich in organic matter (LANA, 1981; MAURER & LEATHEM, 1981; GASTON, 1987; MORGADO, 1988). Nevertheless, in this study these polychaetes were rare in very fine sand and dominated in other kind of sediments. At Barra Velha, for example, high levels of organic matter were found in medium and fine sand with large populations of *Laeonereis acuta* and *Heteromastus filiformis*. This beach is located in the island urban zone, with the sediments enriched by domestic sewage. According to DAUER & CONNER (1980), coarser sand sediments with low silt-clay contents and low nutrient retention capacity tend to be organically richer under moderate nutrient addition than finer sediments which is similar to this area.

Greater relative abundance of carnivorous polychaetes in coarser sediments is related to substrate physical characteristics. Many of the intertidal carnivores are small, depending on size of the sediment interstices to locomotion and prey capture (GASTON, 1987).

The dominance of motile forms and the scarcity of sessile ones reflect the dynamic sediment nature. In more stable habitats, with a high content of silt-clay and organic carbon, sessile polychaetes become more abundant (MAURER & LEATHEM, 1981; GASTON, 1987).

Detritivores distribution and abundance throughout the sites suggest that most of the particulate organic matter occurred in the sediment-water interface. In the richest sediments, resources were also available for subsurface deposit-feeders.

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