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Benthic foraminiferal assemblages and morphological abnormalities in the Subaé estuarine system, Bahia – Brazil

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Several strategies can be adopted to characterize, evaluate and monitor environmental quality. Historically, the determination of physical-chemical variables by analytic methods has been prioritized in polluted areas. Nevertheless, there are several organisms, called bioindicators, which can be used as environmental indicators, being that the success of evaluation plans or environmental monitoring depends mainly on the correct choice of the bioindicator. Among the benthic organisms used for assessing anthropogenic effects, benthic foraminifera are one of the preferred groups because they are very sensitive to environmental stress. Studies dealing with benthic foraminifera as bioindicators of pollution have been increasing over the last decades. These studies have shown that the distribution of benthic foraminifera is affected by several anthropogenic stressors, like organic enrichment of the sediments, heavy metal load and petroleum hydrocarbons. Foraminiferal responses to these conditions can include shifts in abundance patterns, species composition and the presence of test's abnormalities. This study aims:

- 1) to record the benthic foraminiferal assemblages in the Subaé Estuary (an impacted area);
- 2) to study the mineralogical test composition of those species that show high number of abnormal tests;
- 3) to relate this aspects to environmental conditions.

The Subaé estuarine system is situated in the northwest of Todos os Santos Bay, Brazil between 12°15'27"-12°32'30"S and 38°36'00"-38°42'30"W. It drains a 3,170,000 km² basin with a maximum high tide of 2.60 m in Gonçalves dos Campos. The mean annual river flow is 4.5 m³s⁻¹. The area is affected by different pollutants, which derive from different sources such as domestic sewage, industrial effluents and solid residues coming from Santo Amaro da Purificação and São Francisco do Conde municipalities. Chemical analyzes of sediments showed concentrations of Pb 363.4 (mg/kg) and Cr 113.1 (mg/kg).

A total of 52 stations were sampled using a Petersen grab. Preparation and analysis of biological samples followed a conventional methodology and identification. To estimate heavy metal concentrations within the foraminiferal tests, analyzes were made on living normal and aberrant tests using an Energy Dispersive Spectrometer. Biological data were analyzed with uni and multivariate techniques. Specific diversity (H' , \log_e) was determined using the Shannon-Wiener index. Evenness (J') was calculated according to Pielou index and species richness (S) was defined as the total number of species recorded at each station. The absolute density for each station was used for the construction of biological similarity matrixes to cluster analysis (Q Mode and R Mode). A Principal Component Analysis (PCA) was carried out for the ordination of the sample locations based on abiotic factors. Benthic species observed in the study area are all shallow-water forms and most of them have been recorded before in the Brazilian coastal region. A total of 58 species and 8762 individuals were found belonging to the suborders Rotaliina (76.18%), Textulariina (22.59%) and Miliolina (1.11%). The H' ranged between 0.325 and 2.203 and the J' between 0.392 and 0.887. Two stations located near the sewage discharge zone were azoic. Through the *Ammonia tepida* / *Elphidium excavatum* assemblage and the *Ammotium salsum* assemblage was possible to distinguish 2 principal sub-environments, which reflected the behavior of both, natural and anthropogenic induced environmental tensors, on foraminiferal communities. Abnormal tests were specially related to *A. tepida*, *E. excavatum* and *E. discoidale* species. The high percentages of abnormal tests and their geochemical composition seem to be related to heavy metal contamination within the study area.

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