FORAMS 2006

Relationship between foraminifera and bacteria in estuarine sediments from Santa Catarina Island, Brazil

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Bacteria represent the largest portion of biomass of any other benthic microorganisms as organic or inorganic substrates, because the biofilms increases their volume/surface ratio. Micro organisms develop microhabitats depending on biological and physical-chemical parameters that could interact positively or negatively with organisms that intensively colonize mangrove sediments. Protozoa are an important link between the microbial loop and the food web, because they assimilate 80% of energy produced by autotrophic and transferring 28% to the next level. Therefore understanding the relationship between tropical foraminifera and bacteria is important. To investigate this relationship, sediment samples were taken along six stations in Itacorubi River located inside of Florianópolis urban perimeter, where the southernmost mangrove vegetation occurs in Brazil. The aim of this research is to analyze the relationship between foraminifera population/distribution and bacterial respiratory activity (BRA) in sediment, and its ecological significance. Inside the mangrove area, the stations were distributed from the external region (stations 01, 02 and 06), to the internal region of the estuary (stations 03, 04 and 05). Station 05 was located next to an older landfill. Sediment samples were collected to perform foraminifera analysis, BRA (fermentation, nitrification and sulphate reduction)**,** grain-size analysis, organic matter (OM) and bacterial carbon (BC). Water samples were taken for inorganic ions analysis (N-NH_4, N-NO_3, N-NO_2, DIN, PO_4 and SiO_3).

Estuary temperature varied between 17.9 and 18.4^{0}C, while bottom salinity varied from 31.9 to 34.7%. The pH didn't vary much, with values between 7.75 and 7.86. Dissolved oxygen varied from 3.35 to 4.05 ml.L^{-1}. The turbidity expressed a variation from 16.9 to 27.4 NTU. The prevailing textural class was muddy silt in upstream and sandy silt downstream. OM varied from

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3.58 to 4.54%. N-NH$_4$ was detected only at station 05. Station 01 was the set which N-NO$_3$ not detected, in other stations it varied between 0.12–0.28 mg.L^{-1}, with station 05 showing the biggest value (0.40 mg.L^{-1}). N-NO$_2$ was similar to N-NO$_3$, not present in station 01 but varying from 0.01 to 0,02 mg.L^{-1} in the inner mangrove stations. DIN varied between 0.13 to 0.98 mg.L^{-1}; with hight value at station 05. PO$_4$ varied between 0.09 and 0.23 mg.L^{-1} and SiO$_3$ varied between 0.87 and 1.77 mg.L^{-1}, with station 05 having the highest value.

BRA showed similar values in all stations with aerobiosis, fermentation and denitrification. Sulphate reduction is present at stations 02, 03, 04 and 05. BC varied between 0,009 and 0,031 µg C. cm^{-3} with the largest value at station 05. For foraminifera, 28 species were identified, with dominance of *A. beccarii* at stations 01 and 02; *A. mexicana* at stations 03, 04 and 05.

Correlation analyses using Spearman technique was performed to understand how the environment variables and the organisms can be correlated in Itacorubi estuary. The relative frequency of *A. mexicana* was related positively with organic enrichment, hypoxia and the presence of sulphate reduction bacteria. The opposite occurred with calcareous species, mainly *A. beccariii.* The correlation matrix was performed followed by MDS analysis (Multidimensional Scaling), had differential three station groups in Itacorubi estuary, probably indicating confinement gradient and environment stress:
  o   Group A - marine biotic and abiotic conditions;
  o   Group B - abundance of species with no dominancy in the outer estuary;
  o   Group C - exhibited environment features of an inner estuary.

These results suggest natural estuary conditions, despite station 05 being next to a so eutrophicated landfill area, indicating a recovering gradient downstream into the Itacorubi estuary. The integrated techniques of foraminifera analysis, bacterial respiratory activity with environment parameters can be an efficient environmental tool to diagnose changes in transitional environments.