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MONITORING THE IMPACT OF HUMAN ACTIVITIES IN ADMIRALTY BAY, KING GEORGE ISLAND, ANTARCTICA: PRELIMINARY RESULTS OF THE MEIOFAUNA COMMUNITY

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Thaïs Navajas Corbisier[1,*], Paula Foltran Gheller[1], Maria Claúdia Yuri Ujikawa[1], Sandra Bromberg[1], Mônica A. Varella Petti[1]

[1]Instituto Oceanográfico, Universidade de São Paulo – USP, São Paulo, SP, Brazil
*e-mail: tncorbis@usp.br

Abstract: *Meiofauna is a component of the marine benthos widely used in environmental impact studies, especially in coastal areas. A monitoring program of Admiralty Bay has been underway since 2008 (INCT-APA/CNPq), and in the summer of 2010, the meiofauna and the phytodetritus were sampled at two sites in three areas of Martel Inlet (CF, UP, BP) and at one area in Mackellar Inlet (RE). Densities were in the range of those found in previous studies in the bay and did not differ significantly between the eight sampling sites. Nevertheless lower densities (<3,000 inds. 4.9 cm²) were found at one site in front of the Brazilian Station (CF1), under the influence of the sewage outfall, and at other three sites. Higher densities (>5,000 inds. 4.9 cm²) were found at Ullmann Point (UP) and at one site in Botany Point (BP1). Nematodes were the dominant meiofauna group. A change in the meiobenthic community structure was detected at the site under the sewage outfall influence (CF1: low density, different composition), suggesting some influence of human activities on the benthic system in front of the Brazilian Station.*

Keywords: meiofauna, monitoring, human impact, Admiralty Bay

Introduction

A joint project carried out some years ago (Weber & Montone, 2006) permitted a preliminary characterization of Admiralty Bay marine environment. The influence of sewage and of the aliphatic hydrocarbons (AHs) and polycyclic aromatic hydrocarbons was observed only in Martel Inlet in the proximity of the Brazilian station (EACF) sewage outfall within a distance of 200 m in the water column and of 400 m (human sterols) and 700 m (hydrocarbons) in the sediment. Nonetheless, the dispersion of the sewage plume in the shallow coastal zone of Martel Inlet is favoured by the hydrodynamics, especially influenced by the effect of tides. As a result, the contamination in Admiralty Bay is assumed to be punctual and restricted to the proximities of the EACF, especially concerning the sewage outfall (Martins *et al.*, 2005; Bícego *et al.*, 2009).

Benthic meiofauna is a component of the marine biota widely used in environmental impact studies, especially in coastal areas. Due to its characteristics, such as small size, limited mobility, short life cycle lived entirely in the sediment, reproductive strategy without a larval dispersion phase, and close association with and dependence on the marine bottom (sediment and interstitial water), this community has been widely used for environmental monitoring (Coull & Chandler, 1992; Schratzberger *et al.*, 2000).

Previous meiofauna samplings, including measures of microphytobenthic biomass, were done at 15-20 m depth

in seven areas of Martel Inlet, Admiralty Bay, during two consecutive summers (1996/97 and 1997/98) and revealed that high densities are characteristic of this whole inlet, varying between 1,952 ± 326 and 6,738 ± 1542 ind.10 cm^{-2}, and were correlated with the percentage of gravel, silt and clay (Skowronski & Corbisier, 2002). In both summers, the areas with the highest densities were in front of the Brazilian Station (CF) and Ullman Point (UP), and also Hennequin Point (HP) in the first summer (1996/97), and Plaza Point (PP) in the second (1997/98). There was no significant difference in the densities between the two summers, although the higher microphytobenthic biomass, the potential food for the meiofauna, was found in the first summer.

A meiofauna study was also undertaken in the summer of 2004/2005, at 20-30 m depth, and aimed to verify possible impacts due to the Brazilian activities, comparing CF with a reference area (Botany Point - BP) (Gheller, 2007). Mean densities varied from 7,028 ± 1,529 to 16,245 ± 12,282 ind. 10 cm^{-2} a wider range than that from previous studies. Results showed no significant differences in composition and abundance of meiofauna between the two sampling areas, which suggested no anthropogenic impact near the Brazilian Station.

A continuous monitoring program has been established since 2008 (INCT-APA), and in the summer of 2010, the meiofauna and the microphytobenthos, among other variables, were sampled at three sites in Martel Inlet (CF, UP, BP) and at one site in Mackellar Inlet (RE) in order to verify the environmental status of the area in front of the Brazilian Station (CF) in comparison to reference areas.

Material and Methods

Samplings were done at 20-30 m depth in four areas of Admiralty Bay, during February 2010 (Figure 1). In each area, two sites (200 m distant) were sampled with a 0.04 m^2 mini box-corer in triplicate. From each box corer one meiofauna sample was obtained from the sediment with a cylindrical copper corer (area of 4.9 cm^2), sectioned into 2 cm layers up to 10 cm, and formalin preserved. In

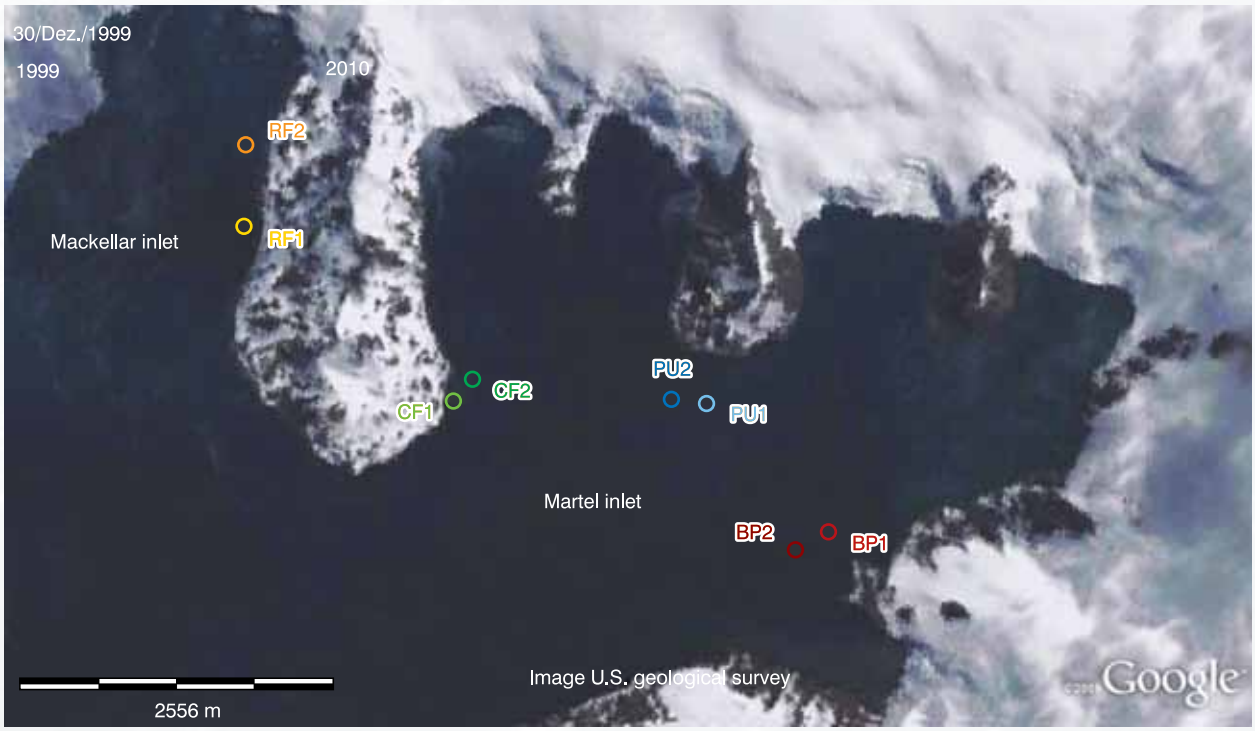

Figure 1. Admiralty Bay and the sampling sites (Google Earth, 2011).

the laboratory, samples were stained with rose bengal and washed through 0.5 mm and 0.063 mm meshes. Animals between these sieves were sorted to higher taxonomic groups and counted. The first two layers of the sediment (0 to 4 cm) were sorted up to date. Sediment samples for grain size, phytopigments biomass (0-1 cm), and organic matter and hydrocarbon analysis were also obtained from each box corer.

The mean meiofauna density and standard-deviation of the replicates from 0-4 cm of the sediment were calculated for each site. Significant differences were investigated using the Kruskal-Wallis test ($p < 0.05$). Spearman rank was applied to search for correlation between meiofauna density and phytopigments biomass and organic matter percentage (BioEstat v.4). An ordination nMDS analysis was done considering the main meiofauna taxonomic groups at the eight sampling sites (Primer v6).

Results

A total of 103,557 meiofaunal organisms were recorded in the first layers of sediment. The densities ranged from 972 ± 317 (mean± SD) at RF1 to 8,166 ± 5,612 ind.4.9 cm^{-2} at UP2 (Figure 2). Mean densities were lower than 3,000 ind. 4.9 cm^{-2} at CF1, BP2, RF1 and RF2, but these were not significantly different from those at the other four points (mean densities > 5,000 ind. 4.9 cm^{-2}) ($H = 133.2$, $p = 0.065$). The meiofauna density presented positive correlation with the sediment organic matter ($p < 0.05$), and not with the chlorophyll-*a* and phaeopigment biomasses.

Nematodes were dominant, representing between 79% and 99% of the total meiofauna (Figure 3). In RF Polychaeta (6%), Nauplii (5%) and Copepoda (3%) showed higher representation than at the other points. In CF1, under the sewage outfall influence, the dominance of Nematodes was higher, and other taxa were nearly absent.

In the nMDS analysis considering the main meiofauna groups, CF1 and RF (1 and 2) were separated from the other sampling sites (Figure 4).

Discussion

Densities were high and in the range of those observed in previous studies in Admiralty Bay (Skowronski *et al.*, 1998; Skowronski & Corbisier, 2002; Gheller, 2007). A higher mean density was observed in UP (around 16,000 ind. 10 cm^{-2}), in

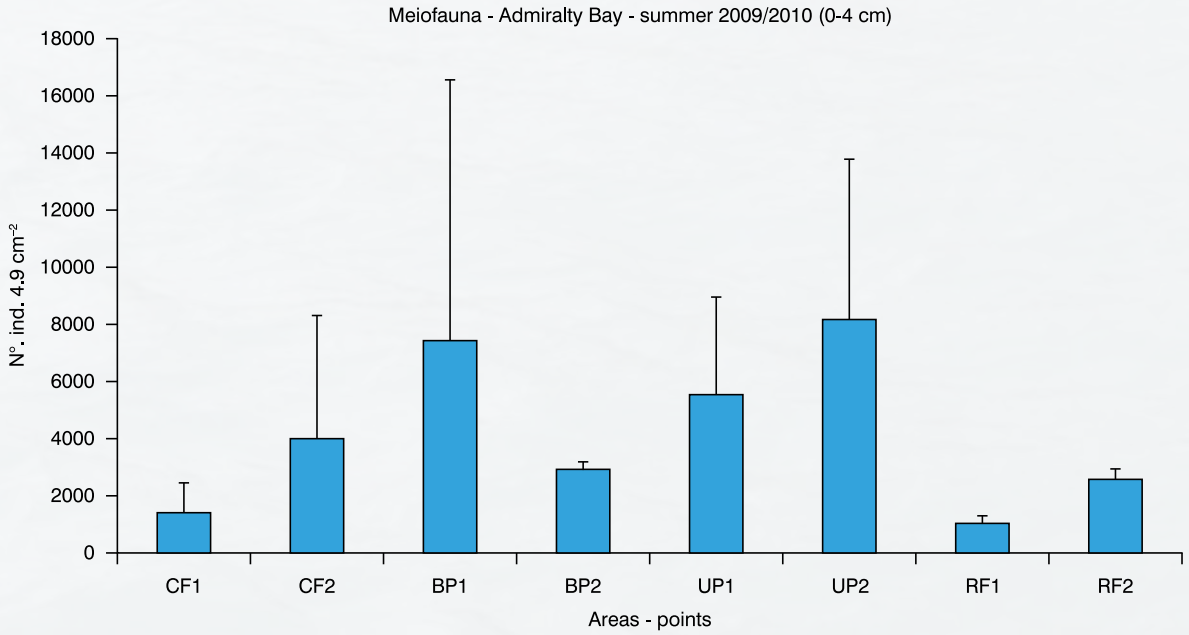

Figure 2. Meiofauna density (mean + standard deviation) at each sampling site at the four studied areas in Admiralty Bay.

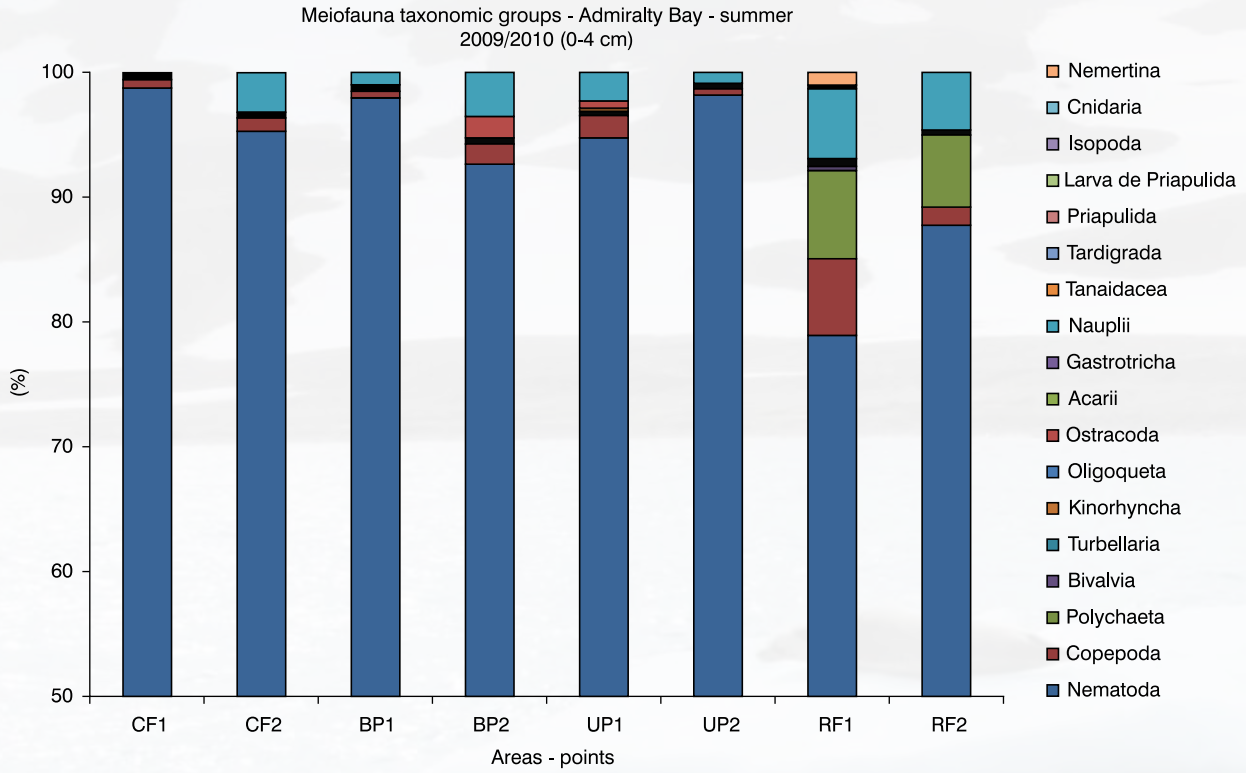

Figure 3. Relative percentage of meiofauna taxa at each sampling site at the four studied areas in Admiralty Bay.

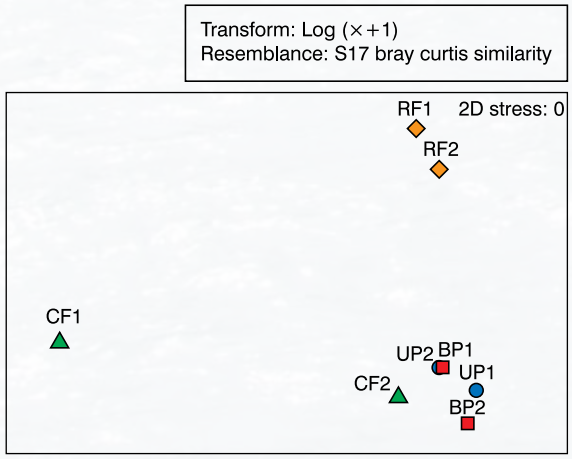

Figure 4. nMDS display of the sampling sites at the four studied areas in Admiralty Bay.

the range of densities found in the beginning of the summer of 2004 in CF and BP (Gheller, 2007). CF1, BP2, RF1 and RF2 had lower meiofauna densities (less than 6,000 ind. 10 cm^{-2}), especially CF1 and RF1 with mean densities of 2,701 and 1,983 ind. 10 cm^{-2}, respectively. Regarding CF1, under the sewage outfall influence, previous mean densities (Skowronski & Corbisier, 2002; Gheller, 2007) were two to four times higher than that found in the present study. On the other hand, at CF2, in front of the oil tanks, the mean density was high (around 12,000 ind. 10 cm^{-2}) and similar to that found in the summer of 2004 (Gheller, 2007).

Sediment features and availability of microphytobenthos/phytodetritus, as a potential food source, are important factors determining the meiofauna distribution in Antarctic seas (Vanhove *et al.*, 1998; Skowronski & Corbisier, 2002). Both chlorophyll-*a* and phaeopigment biomasses did not correlate to meiofauna density, although sediment organic matter percentage did. It was not possible to relate those differences to sediment grain size and contaminants, which results are not available yet.

The fact that a difference in the meiobenthic community structure in CF1 (lower density and distinct meiofauna composition) was detected, suggests that some

impact due to human activities at this site in front of the Brazilian Station is possible, although of small magnitude and range in the benthic system. Additional studies on the benthic community (mega and macrofauna) and other biotic and abiotic components of the bay will contribute to a better understand of the real antropogenic influence in the area.

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References

Bícego, M.C.; Zanardi,-Lamardo, E.; Taniguchi, S.; Martins, C.C.; Silva, D.A.M.; Sasaki, S.T.; Albergaria-Barbosa, A.C.R.; Paolo, F.S.; Weber, R.R. & Montone, R.C. (2009). Results from a 15-year study on hydrocarbon concentrations in water and sediment from Admiralty Bay, King George Island, Antarctica. Antarctic Science, 21(3): 209-20.

Coull, B.C. & Chandler, G.T. (1992). Pollution and meiofauna: field, laboratory, and mesocosm studies. Oceanography and Marine Biology: An Annual Review, 30: 191-271.

Gheller, P.F. (2007). A meiofauna e os Nematoda da enseada Martel (Antártica) e seu uso em monitoramento ambiental. Dissertação de Mestrado. Universidade de São Paulo, Instituto Oceanográfico, 103 p.

Google Earth 6.0.3 (2011). Available from: <http://www.gogle.com.br/intl/pt-BR/earth/index.html.>

Martins, C.C.; Montone, R.C.; Gamba, R.C. & Pellizari, V.H. (2005). Sterols and fecal indicator microorganisms in sediments from Admiralty Bay, Antarctica. Brazilian Journal of Oceanography, 53(1-2): 1-12.

Schratzberger, M; Gee, J.M; Rees, H.L; Boyd, S.E. & Wall, C.M. (2000). The structure and taxonomic composition of sublittoral meiofauna assemblages as an indicator of the status of marine environments. Journal of the Marine Biological Association of the United Kingdom, 80(6): 969-80.

Skowronski, R.S.P.; Corbisier, T.N. & Robles, F.R. (1998). Meiofauna along a coastal transect in Admiralty Bay, King George Island (Antarctica). Pesquisa Antártica Brasileira, 3(1): 117-31.

Skowronski, R.S.P. & Corbisier, T.N. (2002). Meiofauna distribution in Martel Inlet, King George Island (Antarctica): sediment features versus food availability. Polar Biology, 25(2): 126-34.

Vanhove, S.; Beghyn, M.; Van Gansbeke, D.; Brockington, S. & Vincx, M. (1998) The metazoan meiofauna in its biogeochemical environment: the case of an antarctic coastal sediment. Journal of the Marine Biological Association of the United Kingdom, 78(2): 411-34.

Weber, R. R. & Montone, R. C. (Coord.) (2006). Rede-2: Gerenciamento ambiental na Baía do Almirantado, Ilha Rei George, Antártica. Relatório final. Ministério do Meio Ambiente/ CNPq/SeCIRM/Proantar, Brasil. 255 p.