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Size and metal concentration in the mangrove mussel *Mytella guyanensis* (Mollusca: Bivalva) from Baía de Sepetiba, Brazil

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Resumen: Las concentraciones de metales (Cu, Cr, Zn, Cd, Mn y Pb) fueron medidas en tejidos blandos y en conchas del mejillón de manglar, *Mytella guyanensis* en la Bahía de Sepetiba, en el estado de Rio de Janeiro, Brasil. Se establecieron las relaciones entre estas variables y el tamaño del animal para verificar su utilización en la vigilancia de la contaminación en la bahía.

Las concentraciones de Zn, Mn, Pb y Cr disminuyen con relación al incremento de peso del animal. La concentración de Cd crece con el tamaño del animal, mientras que el Cu presenta concentraciones constantes independientes del tamaño.

Una comparación con resultados obtenidos en especies relacionadas de mejillones de regiones templadas, muestra diferencias significativas, por lo que estas diferencias deberán ser consideradas en la elección de especies tropicales en programas de vigilancia ambiental.

In the last two decades, bivalve mollusks of the family Mytillidaea have been widely used as biological monitors for metal pollution in coastal areas due to their ability to concentrate metals in seawater, their great abundance and their wide distribution. Although variations of metal concentrations in mussels are known to occur, due to physiological and environmental variables (e.g. size, sex, season; Orren *et al.*, 1980; Boalch *et al.*, 1981; Latouche *et al.*, 1982) little is known of their effect on mussel species other than those frequently used by environmental monitoring programs in temperate latitudes (e.g. *Mytillus edulis*).

The mangrove mussel *Mytella guyanensis* (Lamarck) is one of the most abundant inhabitants of mangrove and estuarine sediments in tropical America (Klappenbach, 1965), and is the only representative of the Mytillidaea family in many areas. This species is actually under study as a biological monitor at the Baía de Sepetiba, a shallow bay approximately 60 km South of the city of Rio de Janeiro, Brazil, an area with increasing industrial activity and growing pollution problems.

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This preliminary study was developed to estimate the natural variability of metal concentrations in *M. guyanensis*. The chosen parameter was size, since it is well correlated with most other metabolic functions and is of major concern in developing monitoring programs (Boyden, 1974). Because a growing interest in using mollusk shells as metal monitors is arising (Carriker *et al.*, 1980; Sturesson, 1978), both, total soft tissues and shells were analyzed in order to compare between the two and to determine the most adequate.

The sampled area is in the mangrove swamp of Itingussú, Baía de Sepetiba, Rio de Janeiro State (Fig. 1), an area with increasing industrial activity and consequently with moderate levels of heavy metals in the aquatic environment. One hundred and five individuals were manually collected during low tide, thoroughly washed in local sea water and transported in plastic bags to the laboratory, where mussels were stored frozen (-20°C) for analysis.

Prior to analysis, mussels were measured, soft tissue was separated from shells with a stainless steel spatula covered with teflon; all samples were classified by size. Stored samples (n = 26) with 3 to 6 individuals each, were oven dried (80°C-24 h), weighed and ignited (450°C-24 h). A sample of 21

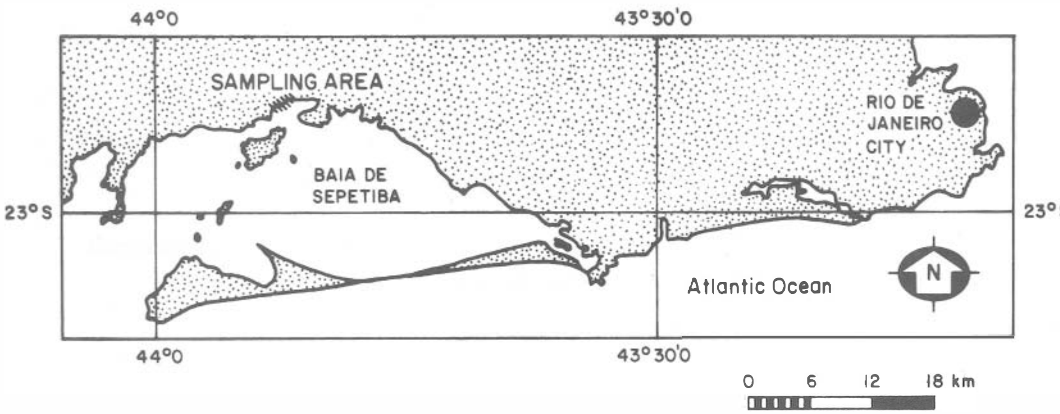

Fig. 1. Map showing geographical location of the Baía de Sepetiba in relation to the city of Rio de Janeiro, and the sampling area in the bay.

TABLE 1

Metal concentration in M. guyanensis, *and abiotic compartments of the studied area* (*μg g*$^{-1}$ *dry weight*)

	Cu	Cr	Cd	Zn	Mn	Pb
M. guyanensis (whole tissue)						
X ± SD	10.22 ± 2.19	4.98 ± 3.52	1.83 ± 0.53	99.91 ± 26.50	17.88 ± 3.89	5.06 ± 2.78 *
Range	(7.24 – 17.35)	(1.59 ± 11.93)	(1.18 – 3.10)	(56.88 – 169.95)	(12.63 – 26.14)	(13.64 – 2.25)
n = 26						
M. guyanensis (shell)						
X ± SD	2.56 ± 1.98	2.25 ± 1.64	1.34 ± 0.81	4.49 ± 3.33**	7.15 ± 5.06	
Range	(0.08 – 6.61)	(0.22 – 6.81)	(0.18 – 2.79)	(0.35 – 11.35)	(0.86 – 17.01)	–
Bottom Sediment	37	8.2	6.2	379	484	15.4
Suspended Particles	75.50	148.68	2.85	365	465.68	68.93
n = 6	5	5	2	5	5	3

* n = 20 ** n = 34

mussels was individually measured, dried and weighed in order to establish the weight-size relationship. Ashes were digested in HCl + HNO_3 (1:3), evaporated and redissolved in 0,1N HCl. Metals (Cu, Cr, Cd, Pb, Mn and Zn) were measured in the 0,1N HCl extract, by conventional flame atomic absorption spectrophotometry, in a Varian Techtron AA-120 spectrophotometer. Mussel shells were thoroughly washed in deionized water, separated by size and analyzed following the same procedure as described for soft tissues. Lead could not be measured in shells due to matrix problems. The total number of samples was 35. The results were expressed in μg of metal per g of dried soft tissue, and per g of dried shell.

The results of metal concentrations in the mussel (soft tissue and shells), and suspended and bottom sediments are presented in Table 1. All metals had higher concentrations in soft tissues than in shells and showed wide ranges in both.

According to Boyden (1977) the ratio of metal concentrations to weight can be studied by simple linear regression and the slopes determine the rate of increment of metals per unit of weight. Three distinct behaviors of these slopes are considered: $b \cong 0$, meaning metal concentration independent of size; $b < 0$, an inverse relationship with size and $b > 0$, a direct relationship with size. Our results are expressed by size rather than by weight, since this parameter is easily obtained and, in the studied population it was exponentially related with tissue weight ($r^2 = 0.996$; df = 29; $p < 0,001$).

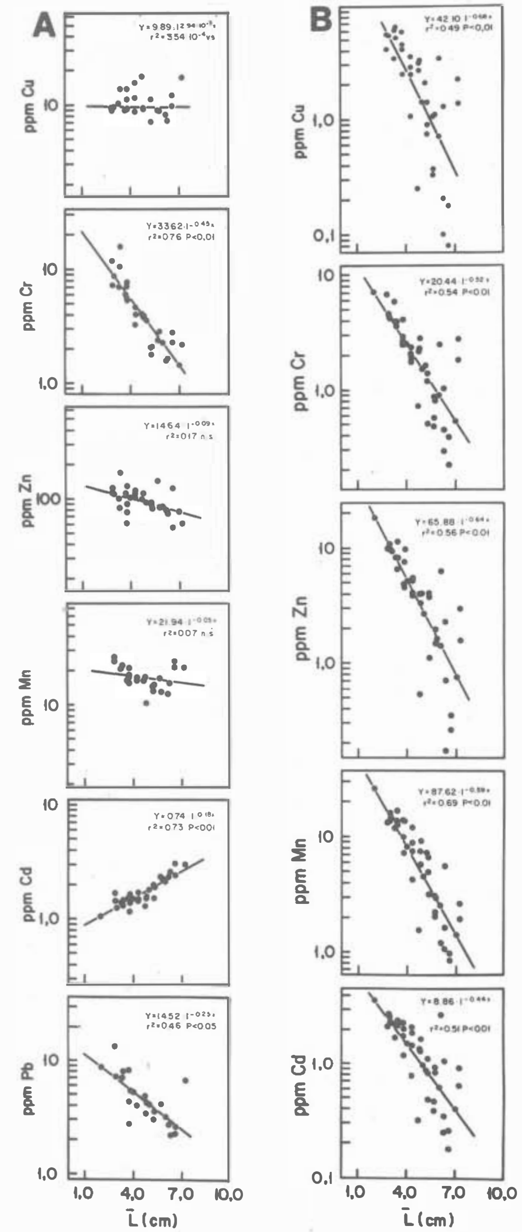

Fig. 2. Relationships between heavy metal concentrations and mussel shell length: A- soft tissues; B- Shells.

The results of the relationship between metal concentrations and shell length are presented in Fig. 2a, for soft tissue and Fig. 2b, for shells.

Three different relationships were found for soft tissues: Zn, Mn, Pb and Cr presented negative slopes, although only Pb and Cr are significant. Cd presented a high significant positive slope, indicating an increasing concentration with increasing size, which contrasts with other studies in mussels from temperate regions (Boyden, 1977, Boalch *et al.*, 1981). However, similar results are described by Latouche and Mix (1982). The last trend found was for Cu, which presented no variation of concentration with size, again a result different from other studies.

The analysis of metals in shells showed a significant inverse relationship for all metals, presenting a constant trend not observed in soft tissues. As the mechanisms of metal uptake and excretion in shells are slower than those of soft tissues, shells should be used as monitoring instruments, and have already been proposed by some authors (Carriker, *et al.*, 1980; Sturesson, 1978).

In conclusion, the results suggest that the relation between metal concentration and size in molluscs is a significant factor to be considered in monitoring programs; these relationships vary with species, and care should be taken in considering results obtained in species from temperate regions and those from the tropics, even when the species are closely related.

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