

# PRELIMINARY ASSESSMENT OF HEAVY METAL LEVELS IN *MYTELLA FALCATA* (BIVALVIA, MYTILIDAE) FROM BACANGA RIVER ESTUARY, SÃO LUÍS, STATE OF MARANHÃO, NORTHEASTERN BRAZIL

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(With 1 figure)

## ABSTRACT

The concentrations of Cu, Zn, Pb, and Cd were determined in the mussel *Mytella falcata* from the Bacanga River estuary, in order to evaluate the potential role of domestic effluents released “in natura” on the quality of the estuarine environment with consequences to shellfish resources. Cu concentrations ranged from 5.2 mg.g<sup>-1</sup> to 13.1 mg.g<sup>-1</sup>, while Zn concentrations ranged from 49.1 mg.g<sup>-1</sup> to 76.3 mg.g<sup>-1</sup>. Pb and Cd showed concentrations lower than 2 mg.g<sup>-1</sup>. The results showed low concentrations of Cu, Pb and Cd in the filter-feeding *Mytella falcata* in the study area in comparison with the maximum values established to foods by the Brazilian Government (Decree Law N° 55,871). Finally, Zn presented slightly higher values than the maximum ones established by the Brazilian government.

*Key words:* heavy metals, bivalves, *Mytella falcata*, estuary, pollution

## RESUMO

### **Avaliação preliminar dos níveis de metais-pesados em *Mytella falcata* (Bivalvia, Mytilidae) do estuário do rio Bacanga, São Luís, Estado do Maranhão, Nordeste do Brasil**

Foram medidas as concentrações de Cu, Zn, Pb e Cd em moluscos bivalves da espécie *Mytella falcata* do estuário do Rio Bacanga, a fim de avaliar uma possível influência do lançamento de esgotos domésticos “in natura” na qualidade deste recurso estuarino. As concentrações de Cu variaram entre 5,2 mg.g<sup>-1</sup> e 13,1 mg.g<sup>-1</sup>, enquanto para o Zn estes valores situaram-se entre 49,1 mg.g<sup>-1</sup> e 76,3 mg.g<sup>-1</sup>. O Pb e o Cd apresentaram valores muito baixos, inferiores a 2 mg.g<sup>-1</sup>. Os resultados indicaram baixas concentrações para o Cu, Pb e Cd nos exemplares de *Mytella falcata* para a área estudada, quando comparadas com os valores máximos estabelecidos pelo Governo Brasileiro (Decreto Lei N° 55.871) para alimentos destinados ao consumo humano. O Zn porém, apresentou valores ligeiramente mais elevados que o máximo recomendável.

*Palavras-chave:* metais pesados, bivalves, *Mytella falcata*, estuário, poluição.

## INTRODUCTION

The indiscriminate release of "in natura" domestic sewage, constitutes one of the main factors of degradation of aquatic ecosystems located near major urban centers, and may contribute to the increase of the concentrations of the heavy metals in these environments. The Bacanga River estuary, located in the West of the island of São Luís (2°33'S and 44°27'W), receives a considerable load of domestic effluents from dense populated residential areas of São Luís city and from residential settlements in its watershed, such as Parque Timbira, Parque dos Nobres and Parque Amazonas (Fig.1). Although submitted to strong anthropogenic pressure, the Bacanga River estuary still presents relatively rich aquatic fauna, composed of a variety of species of fish and molluscs, from which stands out *Mytella falcata* (Bivalvia, Mytilidae), known popularly as sururu. Due to its abundance and easy collection, this species is highly consumed by the local population. Due to their filter-feeding and sedentary habits, they tend to present larger concentrations of heavy metals relative to migrating species (Castro, 1991); therefore they are excellent bioindicators heavy metals pollution.

Juras (1985), reported preliminary results on heavy metals in estuarine organisms of the Southwest zone of São Luís. The fishes *Genyotremus luteus*, *Arius herzbergii* and *Mugil curema*, and the bivalves *Mytella falcata* were analyzed, and the higher levels of Hg, Pb, Cu, Zn and Cd found in the tissues of the molluscs.

Cavalcante *et al.* (1990), reported on the Hg distribution in sediments, estuarine water, and in biota, namely *Mytella falcata* (sururu) and *Crassostrea rhizophorae* (oyster-of-mangrove), collected along the rivers Mearim, Itapecuru and Cachorros, at São Marcos and Arraial Bays, as well as in the Coqueiro and Mosquitos straits.

The aquatic organisms are responsible for a great deal of recycling of metals retained in abiotic compartments of the ecosystem and consequently, they constitute the main pathway of export of heavy metals from the aquatic environment to the terrestrial through the food chain, by which they reach human beings (Fowler in Pfeiffer *et al.*, 1985).

The lack of technical and scientific information that indicate the degree of quality of the

local bodies of water, associated with the physiological and ecological characteristics of the species *Mytella falcata*, justify the development of this study. The main objective of this project is to determine the concentrations of Cu, Pb, Zn and Cd in these organisms and correlate their concentrations with biometric characteristics.

## MATERIAL AND METHODS

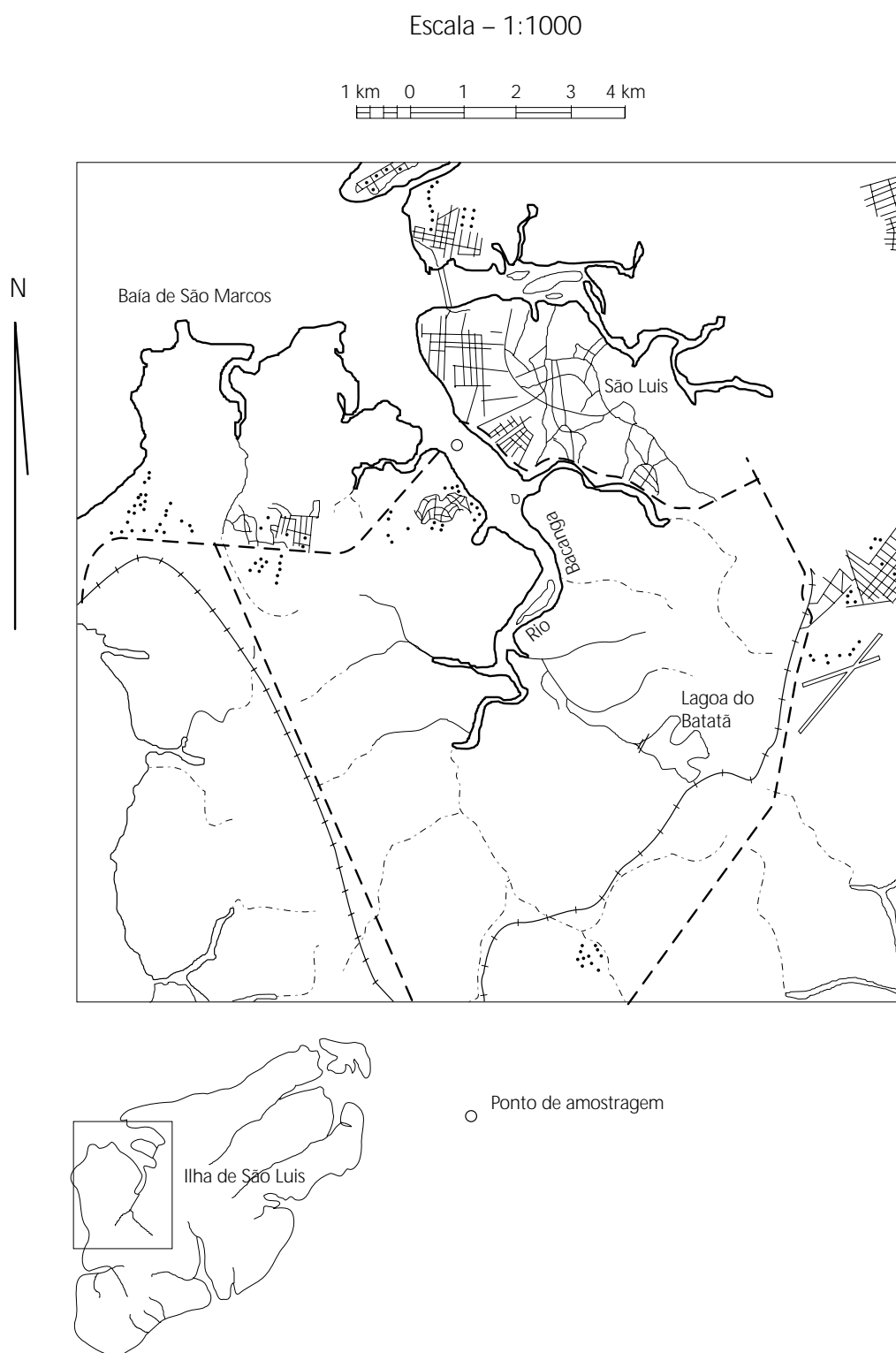
Specimens of *Mytella falcata* were collected between September and October 1996, in the banks close to the points of release of domestic sewage in the area of the Bacanga estuary. The individuals were washed with estuarine water, packed in plastic bag and taken to the laboratory where they were separated by size, forming 3 groups of fifty individuals each: "P" (28.0-30.5 mm in length), "M" (38.0-40.0 mm) and "G" (51.0-55.2 mm), representing small, medium and large animals, respectively.

From each group, thirty individuals were selected to collect biometric data, such as: height, width and length (mm) and weight (g). Following, the animals had their muscle tissues removed and weighed, in order to form at least five replicates, of approximately 4.0 g each. The samples were oven dried (24 h, 105°C), for the determination of the dry weight (generally around one gram) and digested with a mixture of HNO<sub>3</sub> (acid nitric) + H<sub>2</sub>O (1:1) and 150 µL C<sub>8</sub>H<sub>18</sub>O (octhanol), in a block digestor.

The extracts were analysed for of Cu, Pb and Cd by Potentiometric Stripping and Zn by Atomic Absorption Spectrophotometry (Talbot, 1983; Jagner & Aren, 1979; Jagner, 1982; Cavalcante *et al.*, 1994). The results of the analytical determinations of the replicates were expressed in dry weight. In order to test significant difference in the analysed group, Friedman's nonparametric statistical test was conducted.

## RESULTS AND DISCUSSION

The Tables 1 and 2 show, the concentrations of metals in the shellfish from the Bacanga River estuary, compared with literature data. Average Cu concentration is 7.3 mg.g<sup>-1</sup>; which is very low compared to the maximum value 30.0 mg.g<sup>-1</sup>, established to foods by the Brazilian Government (Decree Law N° 55,871).



**Fig. 1** — Map showing the location of studied area.

TABLE 1

Concentration of heavy metals in *Mytella falcata* from the Bacanga River. Range of the concentrations (A), mean concentration (x) and standard deviation (s) with results in  $\text{mg.g}^{-1}$  (dry weight).

SAMPLE LOT (LENGTH mm)	Cu (30.0)*	Zn (50.0)*	Pb (2.0)*	Cd (1.0)*
<i>Small Lot</i> (28.0-30.51)	A = 5.2 – 8.4 x = 7.4 s = 1.3	A = 58.2 – 66.3 x = 60.6 s = 3.3	< 1.0	< 1.0
<i>Medium Lot</i> (38.12-39.90)	A = 6.1 – 9.3 x = 7.4 s = 1.6	A = 49.1 – 58.5 x = 52.5 s = 3.7	< 1.0	< 1.0
<i>Large Lot</i> (51.0-55.20)	A = 6.7 – 13.1 x = 7.2 s = 2.6	A = 49.3 – 76.3 x = 56.0 s = 11.6	< 1.0	< 1.0

Compared to values of previous studies in the area (Juras, 1985), the concentrations of Cu in our study are very low, and very similar to the concentration in the mussel *Perna perna*, from Rio de Janeiro State (Neira *et al.*, 1995).

In spite of Cu being an important component in the blood of invertebrates, responsible for hemocyanine synthesis and oxygen transport (Aragão, 1995; Eysink, 1988) and a good indicator of urban effluents discharge (Neira *et al.*, 1995), its concentrations in the samples are low. These values are comparable to those found in other pristine Brazilian coastal areas.

Lead concentrations are lower than  $1.0 \text{ mg.g}^{-1}$ , being more than 20 times lower than maximum permitted values for human consumption ( $20 \text{ mg.g}^{-1}$ ). Previous data by Juras (1988) from the straits of Coqueiro and Mosquitos ( $< 5,0 \text{ mg.g}^{-1}$ ) are similar to our study. In a general way, Pb is not concentrated in the marine biota even when its concentration in the sediments is high (Phillips in Pfeiffer *et al.*, 1985).

On the other hand, human populations in general, are much more exposed to atmospheric lead, which represents the most important pathway to humans (Bernhard & Zattera, 1973 in Pfeiffer, *et al.*, 1985).

Also, as the presented values are similar to those found by Neira, *et al.* (1995) in mussels from non polluted areas of the SE Brazilian coast, it can be affirmed the study area is less affected by Pb pollution.

The concentrations of Zn ranged from 58.5 to  $76.3 \text{ mg.g}^{-1}$ , are slightly higher than the

maximum values established to foods by the Brazilian Government ( $50.0 \text{ mg.g}^{-1}$ ) (Decree Law N<sup>o</sup> 55,871), and are considerably lower than that found by Lima *et al.* (1986), in *C. brasiliensis* from the Sepetiba Bay area in the Southern Rio de Janeiro coast, considered to be a receiver of effluents from the industrial Zone of Santa Cruz. Juras (1985), found concentrations of Zn between  $68.0 \text{ mg.g}^{-1}$  and  $105.0 \text{ mg.g}^{-1}$  in *Mytella falcata* from the straits of the Coqueiro and Mosquitos, values that are higher than our data.

These results are apparently due to the fact that Zinc is essential element in these organism's metabolism, besides this metal be usually associated, in aquatic environments, with suspended particles which are used by mussels in their filter-feeding diet (Moore & Rammoorthy, 1984).

Similarly to Lead, the levels for Cadmium were inferior to  $1 \text{ mg.g}^{-1}$  and similar concentration found in *Mytella falcata* from the straits of Coqueiro and Mosquitos ( $< 0,5 \text{ mg.g}^{-1}$ ) observed by Juras (1985), which is indicating that Cadmium is not contaminated in the study area.

The results of the statistical nonparametric analysis indicated no significant differences in the concentrations of metals among the different classes of size in the organisms analyzed, although several authors have observed this relationship in field and laboratory studies (Boyden, 1974; Schulz-Baldes, 1974; Cunningham & Tripp, 1975; Phillips, 1976a, 1976b).

In general, the concentrations of Cu, Cd and Pb are low and similar to those found in non polluted areas of the Brazilian coast.

**TABLE 2**  
**Concentrations of Cooper, Zinc, Lead and Cadmium in molluscs from different areas of the Brazilian coast.**

Species	Site Banks	Source		Cu*	Zn*	Pb*	Cd*
		(Author/date)					
<i>C. brasilia</i>	Estuary of Santos	CETESB	1980	77.5	-	-	-
<i>C. rhizophorae</i>	Straits of Coqueiros and Mosquitos	Juras	1985	41	1,560	< 5.0	< 0.5
<i>M. falcata</i> (small)	"	"	1985	53	105	< 5.0	< 0.5
<i>M. Falcata</i> (medium)	"	"	1985	47	81	< 5.0	< 0.5
<i>M.falcata</i> (large)	"	"	1985	44	68	< 5.0	< 0.5
<i>C. brasilia</i>	Sepetiba Bay	Lima <i>et al.</i>	1986	-	1,773-16,130	-	1.5-28.2
<i>C. brasilia</i>	"	Pfeiffer <i>et al.</i>	1985	3.2	973	1.1	1.60
<i>C. rhizophorae</i>	"	"	1985	1,4	471	0.8	0.5
<i>M. guianensis</i>	"	"	1985	1.0-2.2	4.5-84.0	0.4-2.1	0.2-0.9
<i>P. perna</i>	Praia Vermelha	Carvalho & Lacerda	1992	11.0	1,132	4.0	0.1
<i>C. brasilia</i>	"	"	1992	148	1,302	ñd	0.4
<i>P. perna</i>	Boa Viagem	"	1992	99	169	1.0	0.1
<i>P. perna</i>	"	Neira <i>et al.</i>	1995	6.0	207.4	0.8	-
<i>P. perna</i>	Piratining	"	1995	6.9	79.9	0.8	-
<i>P. perna</i>	Itaipu	"	1995	6.2	134.9	0.8	-
<i>P. perna</i>	Itacoatiara	"	1995	8.1	183.5	0.8	-

\* Concentration in  $\mu\text{g}\cdot\text{g}^{-1}$  (dry weight).

Zinc, on the other hand, showed slightly higher values than the maximum ones established to foods by the Brazilian Government. However, a more detailed study is recommended to associate the concentrations of this metal to a larger number of biometric and biological factors of this organism (sex and gonadal maturation) and environmental variables (salinity, pH, seasonally).

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