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Trace Metals in Tropical Coastal Lagoon Bivalves, *Mytella strigata*

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The tropical mussel Mytella strigata (Hanley, 1843) is a lagoonal species which is geographically distributed from the Gulf of California (Guaymas) to the south of Salvador and the Galapagos islands in the Pacific, and from Venezuela to Argentina in the Atlantic Ocean (Keen, 1971).

This study reports the accumulation of nine trace metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) from lagoonal water by the mussel M. strigata during a nine-month period from the Port of Mazatlán, México. The regression relationship which has the highest correlation coefficient between chromium, copper, and iron concentrations in the particulate of water and in mussels is given.

MATERIALS AND METHODS

A population of Mytella strigata and lagoonal water samples were collected at regular intervals between August 1985 and June 1986, in the Port of Mazatlán (northwest coast of Mexico); which is a small coastal lagoon with an area of 16 Km^2 (Fig. 1). Lankford (1977) classifies this lagoon as a "barred inner shelf" type for which the barrier formation dates from the recent Holocene.

Metal concentrations in the organisms sampled (by hand from the mangrove roots) from the intertidal zone at the selected site (Fig. 1), were determined for total flesh; composite samples of 25 individuals were analysed using the procedure described earlier (Páez-Osuna and Marmolejo-Rivas, 1990). Specimen size was maintained between 29 and 35 mm (the longest each month) throughout the work to reduce variation due to size and age and assure that sexually mature specimenes were used in the study.

The water samples were taken (0.5 m of depth) at the same time as the mussels, using previously acid-washed polyetylene bottles. They were filtered as soon as possible after collection (< 12 h) through acid rinsed 0.45 µm (Millipore type HA) filters. Filtrates were acidified with distilled HNO_3 to pH 2. The filters with

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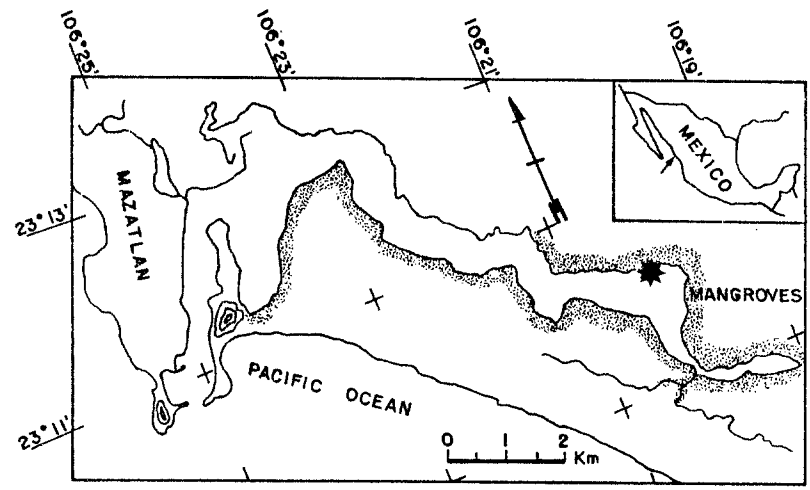

Figure 1. Study area showing the location of sampling site (✱)

particulate material were treated at about 130°C with a 3:1 mixture of HNO_3 and HCl in a teflon decomposition manifold system (Breder, 1982). An IAEA sediment certified sample SD-N-½ (IAEA, 1985), treated in the same way as the samples was used to ensure the accuracy of the analysis. The concentrations of "soluble" trace metals were analysed also following the earlier procedures (Páez-Osuna et al, 1987).

RESULTS AND DISCUSSION

The results of the analysis are presented in the Table 1 and Fig. 2. Cobalt, nickel and zinc in June, and lead and iron in april show the maximum concentration in the soft tissue of M. strigata, while chromium, copper and manganese have an enrichment in the winter months. It is possible that some of the observed fluctuations of manganese and chromium values are not significant (due to precision (3-6%) in the analytical technique) nevertheless large differences between some months are most likely to be valid. Cadmium is maintained relatively constant (0.5-0.6 $\mu g.g^{-1}$) during the months sampled. The relationships between some metals in the mussel M. strigata were significant ($P < 0.05$), for chromium and copper, the r-value (linear correlation coefficient) was 0.73 and manganese fluctuated in an inverse manner with cadmium (r= -0.63). Seasonal variations with highest values in autumn or winter months, have been found in other species of mussels as M. galoprovincialis (Majori et al, 1978), or M. edulis (Amiard et al, 1986).

Seasonal changes in trace metal concentrations have been related to factors such as food supply associated with an increase of productivity resulting from higher temperatures and longer days during spring and summer (probable case for cobalt, nickel, zinc, lead and iron in M. strigata) or changes in run-off of particulate metal to the sea consequent to high precipitations (Fowler and Oregioni, 1976), or simply to seasonal size (age) changes against

Table 1. Port of Mazatlán. Salinity, suspended matter and dissolved and particulate metal concentrations ($\mu g.L^{-1}$).

Month	Salinity (°/₀₀)	suspended matter ($mg.L^{-1}$)	(Dissolved / Particulate) 10^{-2}								
			Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Oct	25.756	44	-/6	35/56	-/79	139/173	481/122	92/3500	336/93	92/200	3610/317
Nov	35.016	65	-/15	42/97	-/114	75/266	308/131	21/5050	278/218	57/377	5400/875
Dec	32.226	76	-/30	-/114	-/102	-/389	-/131	-/5050	-/218	-/551	-/827
Jan	37.942	30	-/13	16/24	-/29	63/79	63/56	14/960	206/55	42/135	840/74
Feb	36.426	48	-/5	20/26	-/42	90/105	181/113	9/2560	163/76	34/171	5690/477
Mar	37.004	38	-/6	65/34	-/53	140/87	384/91	19/1760	353/74	126/176	1900/508
Ap	37.140	47	-/-	32/25	-/61	124/62	272/81	12/1940	203/75	54/125	7080/88
May	37.395	54	-/5	25/56	-/70	163/144	515/133	15/3270	261/127	46/225	5120/403
Jun	37.869	35	-/2	36/6	-/35	204/70	1464/71	42/2560	250/58	107/164	3970/187
Jul	38.449	38	-/4	15/33	-/51	84/82	158/89	15/4160	109/80	45/166	-/231

- not available.

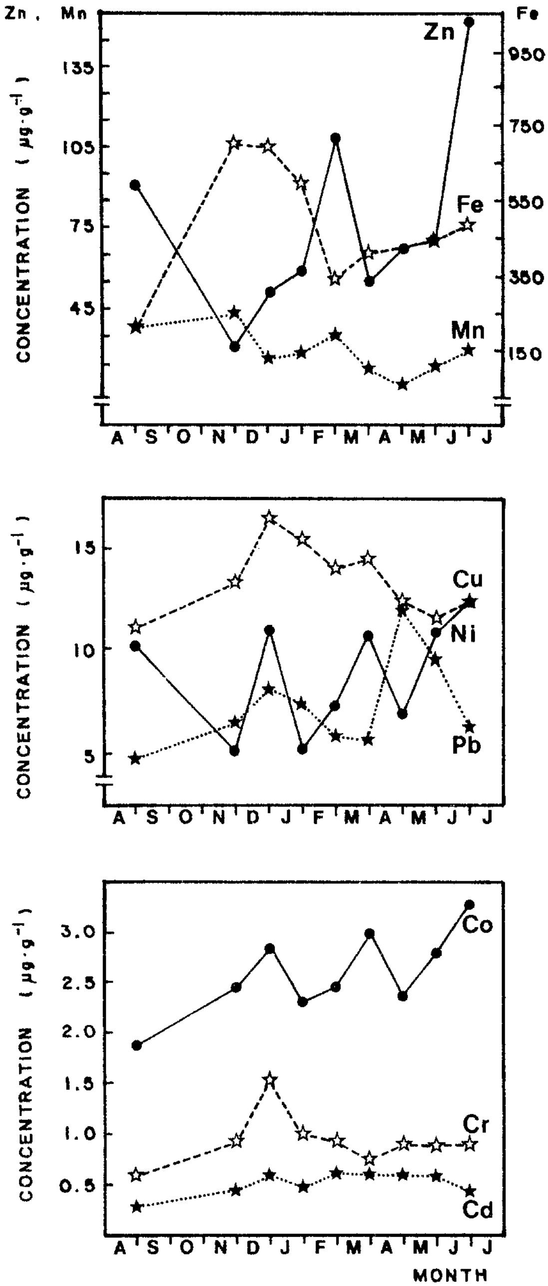

Figure 2. Temporal fluctuations of Cd, Cr, Co, Pb, Ni, Cu, Mn, Fe and Zn in the mussel M. strigata from Port of Mazatlán, Mexico, 1985-1986.

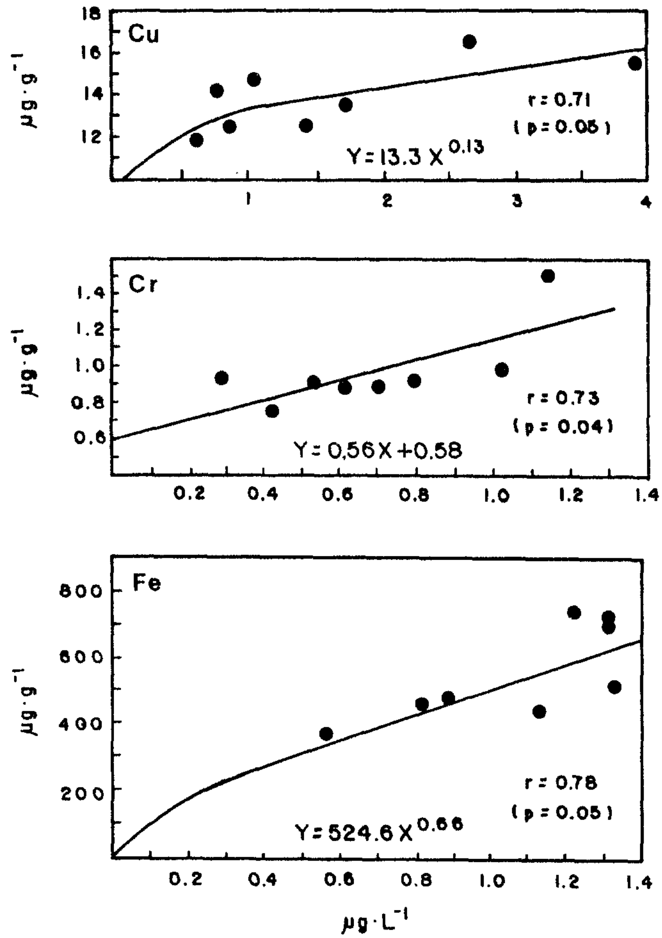

Figure 3. Concentration of trace metals in M. strigata vs. Trace metal content of the particulate fraction (one-month preceding) in the Port of Mazatlán, Mexico.

a metal content during the year (Páez-Osuna and Marmolejo-Rivas, 1990). In M. strigata no correlations with the levels of dissolved metals were observed in the lagoonal water (25.756-38.449°/oo of salinity), nor with the level of metals in the particulate fraction (or both together) corresponding to the same collection time. However, when alternatively the levels of trace elements of M. strigata are correlated with those in the particulate fraction of the month immediately preceding, a significant relationship is obtained for three of the nine metals analysed.

For copper and iron, the relationship in the lagoonal mussel M. strigata (32±2 mm of long) is described by a power function.

$$Y = a X^b$$

while, that for chromium the best equation is a linear function

$$Y = a X + b$$

where in both cases Y is the level of these metals in the mussel ($\mu g.g^{-1}$) and X in the particulate fraction ($\mu g.L^{-1}$) of the lagoonal water of the preceding month (Fig. 3).

These results are partially in concordance with these obtained by Talbot (1985, 1987) in Australia (Port Phillip Bay and Western Port), where a significant equilibrium relationship, found was in the form $Y=a X^b$, between total recoverable lead and cadmium in sea-water and its direct (same collection time) concentrations in the mussel Mytilus edulis. Recently, Amiard et al, (1987) studied experimentally the patterns of accumulation of copper, zinc, cadmium and lead of some species of molluscs (M. edulis) exposed to short-term contaminations (96 h), and found that the levels in the organisms depend mainly on their environmental concentration according to the same power function.

Data of the present investigation, indirectly suggest that copper, chromium and iron, have a biological half-live in M. strigata of order of one-month or so, but in the rest of the metals (Cd, Co, Ni, Pb, Zn and Mn) the turnover rates are probably different, or the levels in the soft tissue of the lagoonal mussel is not understandable in function only of particulate and/or dissolved metal with each months measurements. Certainly other parameters are necessary to evaluate such as the gonadic activity, sex in the organisms or/and speciation in the waters.

Evidently, the relative lagoonal/estuarine or seawater concentrations of trace metals induced from levels in bivalves will reflect periods of a continual and longer time than those measured directly in water samples recovered from punctual casts. Although as a first approach, the relationships found are valuable because it is possible to estimate the concentration factor and the concentration of metals in water (particulate in M. strigata) which is likely to cause the elements to accumulate in mussels to undesirable concentrations.

Although, there is evidence of problems with the intercomparison of date, with exception of iron, the levels of metals reported in this study are low or comparable to mussels as M. galoprovincialis from Bay Follonica, Italia (Bargagli et al, 1985), P. perna from Guanabana Bay, Brasil (Rezende and Lacerda, 1986), M. californiensis from San Diego Harbor, USA or M. edulis from Rockaway, NY, USA (Goldberg et al, 1983).

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