# HEAVY METAL CONTAMINATION IN A MUGIL WILD POPULATION OF A COASTAL LAGOON.

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**Abstract**

Heavy metals (Zn, Cu and Pb) concentrations in liver of *Mugil saliens* from a coastal lagoon and plasma transaminases levels (AST, ALT and ALP) were measured and their relationships with morphometric parameters (weight, length and age) were investigated. The metal concentrations in the sediments were low to moderate but higher for some metals in the liver (262.08 mg Cu/Kg and 88.64 mg Zn/Kg). The relationships with fish age (6-13 years) were positive for Cu liver content and negative for ALT. The results of this study indicated that the time of exposure is the main factor to control this enzyme, suggesting that copper may be implied in this process.

## Introduction

Polluted sediments usually contain chemical mixtures that may have synergistic and/or antagonistic effects on organisms. Thus, the biomarker responses under the toxicity of whole sediment were of correlative nature [1]. The measurement of enzyme activity is a diagnostic tool used in programs of pollution monitoring in aquatic environments [2, 3]. The Esmoriz/Paramos coastal lagoon, situated in the Northwest coast of Portugal, receives mostly untreated industrial and domestic effluents. Heavy metals are probably contributing to its degradation, leading to species decrease. *Mugil saliens* is one of the remaining fish species in the lagoon.

The aim of this study was to evaluate the contamination in fish, that were born under metal exposure and its implications on transaminase activity.

## Materials and Methods

The sediments were collected between February and March 2003 in different stations (Fig.1) and sub-fractioned along depth. Fish sampling was done in April 2004, at post-spawning period. Thirty five fishes were captured, and the total length and weight was recorded. Livers were removed and blood was collected by the caudal puncture method. The age was determinated, according to the annual ring structure. Metal concentrations were determined according to [4] and [5], in a flame atomic absorption spectrophotometer (FAAS). Analytical quality was checked against reference material. Plasma aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were colorimetrically determined in ten fishes. One-way and two-way ANOVA were used to compare data among groups. Data were tested by Pearson rank correlation and analysed by linear regression.


Fig. 1- Location and sampling sites in Esmoriz/Paramos lagoon. Water inflows: north, Ribeira de Paramos and south, Vala de Maceda .

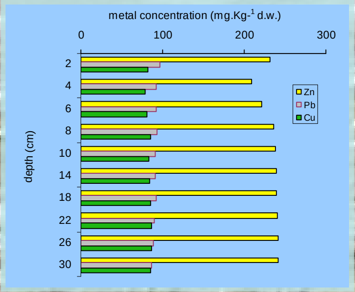


Fig. 2 - Cumulative mean concentrations of metals in sediments along depth.

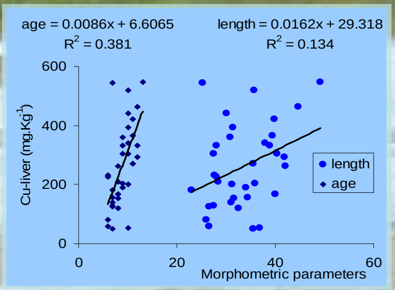


Fig. 3 – Relationships between Cu-liver content and morphometric parameters. (age = p<0.01, length = p<0.05).

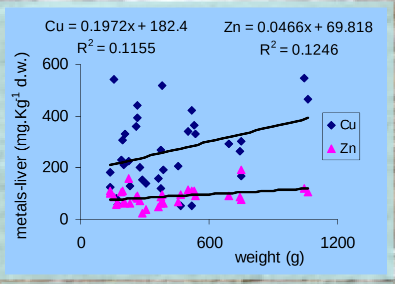


Fig. 4 - Relationships between metal content in liver and weight (p<0.05).

Tab.1 - Morphometric parameters, heavy metal concentrations (mg·Kg$^{-1}$ d.w.) in liver (N = 35) and plasma enzyme activities (N = 10) of *Mugil saliens*.

| Variables | Mean ± sd |
|---|---|
| Total weight (g) | 403.93 ± 242.46 |
| Length (cm) | 33.57 ± 6.24 |
| Age (years) | 9 (range = 6-13) |
| Cu-liver | 262.08 ± 140.71 |
| Zn-liver | 88.64 ± 32.00 |
| Pb-liver | < 6.52 |
| ALP (U/L) | 32.44 ± 16.55 |
| ALT (U/L) | 4.13 ± 2.47 |
| AST (U/L) | 255.10 ± 132.08 |

Tab. 2 – Pearson correlations between plasma enzyme levels and morphometric parameters. * p<0.05

| | | Plasma enzyme levels | | |
|---|---|---|---|---|
| | | ALP | ALT | AST |
| Morphometrc parameters | weight | 0.043 | -0.667 | 0.188 |
| | length | 0.186 | -0.822 * | 0.178 |
| | age | 0.290 | -0.766 * | -0.073 |

## Results and Discussions

Metal concentrations of sediments varied significantly (P<0.05) between stations and with depth however cumulative mean concentrations, for all stations, of each metal along depth/years showed no significant differences (Fig. 2). Therefore the estimated mean values of the metal concentrations that fish have been exposed to were 234 mg Zn·kg$^{-1}$ d.w., 84 mg Cu·kg$^{-1}$ d.w, and 91 mg Pb·kg$^{-1}$ d.w.. These concentrations were below the guidelines non associated with biological effects [6]. However in liver relatively high concentrations were quantified, for Cu and Zn (Tab. 1) showing that fish liver is the main organ involved in storage and detoxification of metals [7]. Low levels of Pb were found in liver which may indicate the bioavailability and uptake of this metal in the lagoon.

The present data showed that there is a significant relationship between Cu liver content and fish age (and size) (Fig.3).

This can be explained by the changes on the uptake and depuration mechanisms that occur due to chronic exposure to heavy metals. The time of permanency of *M. saliens* in the lagoon affects its metal regulation leading to Cu accumulation in the liver of older individuals. No relationship was observed between liver Zn levels and fish age (and size), but it was significant with weight (Fig. 4). One explanation for these relationships may be the alterations in fish feeding habits and smaller growth rate in old fish, thus correlations with age, rather than length or weight, seems more accurate. It seems that Zn accumulates up to a certain level and then remains within an interval. This study showed a clear negative relationship between ALT concentration and fish age (and length) (Tab. 2 ), suggesting that transaminase activity may be inhibited through Cu accumulation with exposure time.

## Conclusions

Although the metal concentrations in sediments are low to moderate, the time of exposure caused heavy metal accumulation in fish liver.

The Cu is accumulated in the liver, over the homeostatic capacity, while Zn was subjected to a mechanism of regulation. The biological effects included a decreased in the transaminase activity with fish age.

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