

Changes in plasma electrolytes and Gill Histopathology in Wild *Liza saliens* from the Esmoriz-Paramos Coastal Lagoon, Portugal

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The Esmoriz-Paramos is a lagoon of great ecological significance located on the Northwest coast of Portugal. The quality of water and sediment within this ecosystem has been gradually degraded due to the discharges of mostly untreated industrial waste and domestic sewage. Contaminants include heavy metals that can be taken up by fish from water, food, sediments, and suspended particulate material. Fish inhabiting polluted water bodies tend to accumulate many chemicals in high concentrations, even when the environmental contamination levels are low (Colombo et al. 1995). The leaping grey mullet (*Liza saliens*) is one of a few dominant species living in this environment. This species may contact xenobiotics in the water column or, when feeding, in the sediments.

Previous studies have analyzed heavy metal concentrations in the water and sediments of this lagoon, and evaluated their bioaccumulation in *L. saliens* (Fernandes et al. 2007a, b). According to these studies, the seasonal range of metal concentrations in surface water was 0.003–0.031 mg Cu·L⁻¹, 0.006–0.811 mg Zn·L⁻¹ and 0.01–0.026 mg Pb·L⁻¹,

all mainly found in particulate matter. The main metals found in sediments were Cu, Zn and Pb, respectively 83, 241 and 87 mg·kg⁻¹d.w. The Cu and Zn concentrations in *L. saliens* liver were 262 and 89 mg·kg⁻¹d.w. and below the detection limit for Pb (0.073 ppm), whereas these concentrations in the gill were 9 mg Cu·kg⁻¹ d.w.; 114 mg Zn·kg⁻¹ d.w. and 0.6 mg Pb·kg⁻¹ d.w. Also, significant age-related increase of metal concentrations in tissues, were noted, for Zn in gill and for Cu in liver and gill (Fernandes et al. 2007a).

The gill is particularly sensitive to physical and chemical changes in the aquatic environment and it is the main target organ in fish for toxic waterborne heavy metals (McDonald and Wood 1993). Effects of metals on ionoregulatory gill functions have been well demonstrated, including regulation of plasma electrolytes (Mazon et al. 2002; Grosell et al. 2003; Martinez et al. 2004). The histological effects of metals on fish gill have also been studied in several fish species (Arellano et al. 1999; De Boeck et al. 2001). The mechanisms of acute Cu toxicity include the osmoregulatory disturbances involving Na⁺, Cl⁻ and K⁺ uptake by the gill (Mazon et al. 2002; Grosell et al. 2003). Although the mechanisms of heavy metals toxicity are well known in acute exposure, the process may differ in chronic exposure (Handy 2003).

The objectives of this study were to evaluate the plasma electrolyte concentrations of wild *Liza saliens* from the Esmoriz-Paramos lagoon and to assess the osmoregulatory responses and branchial histopathological changes related to chronic heavy metal exposure in this habitat.

Materials and Methods

Mugilidae specimens were captured from the Esmoriz-Paramos lagoon and from the sea, in April 2004 in post-

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