THE EFFECT OF METALS ON CONDITION AND PATHOLOGIES OF EUROPEAN EEL (Anguilla anguilla): IN SITU AND LABORATORY EXPERIMENTS

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Forty-nine wild eels (Anguilla anguilla) caught in the Albufera Lake (Spain), measuring 24.0 to 75.0 cm in length and 25.0 to 637.7 g in weight, were examined for metals (Cd, Co, Cr, Cu, Fe, Hg, Mn, Pb, Se and Zn), condition (CI and HSI indices), as well as for diseases (Anguillicola infestation; bacterial infections). Total metal load significantly increased in eel liver tissue parallel to total length and body weight (log), while silverying females (WB > 200 g; L > 500mm) exhibited the highest significant amounts of Co, Cu, Hg, Se and Zn. Diverse effects may be expected in these big eels due to long-term metal exposure, in fact, IMBI (individual mean (multi-metal) bioaccumulation index) and copper load (Ln) in particular, were significantly related with a decrease in the HSI, reflecting lower eel fitness. In addition, most silverying females (75%) showed a CI below 0.2, and this size group presented the highest prevalence of chronic diseases, at significant levels, that are non-lethal short term, but degenerative long term. Amounts of hepatic iron were not correlated with eel size; however, a significant strong negative correlation between this metal (Ln) and HSI and CI was found for wild eels suffering from diseases of any aetiology. This also included small eels (WB < 67g; L < 350mm), as this size group presented a significant prevalence of acute diseases caused by single virulent bacterial pathogens (i.e. Edwardsiella tarda and Vibrio vulnificus biotype 2). To assess the effect of metals on susceptibility to disease, yellow eels were maintained and exposed to iron, copper, and pathogens, in captivity under laboratory conditions. Co-exposure of eels to iron (9 µg of Fe/g of fish) and bacterial pathogens, by intraperitoneal injection (IP), yielded a hundred-fold reduction in the LD₉₀ of all bacteria assayed (i.e. Edwardsiella tarda, Vibrio vulnificus, and motile Aeromonas), and also the time taken to cause eel death. Short-term aqueous exposure of eels to 0.4, 0.7, 1.7 and 3.9 µM of copper, yielded increasing mortality among eels IP challenged by a single dose of 1.90x10⁶ E. tarda cells, and this effect was significant for 1.7 µM of copper. These results suggest a synergistic interaction among copper and iron, and bacterial disease agents, with respect to their effect on eel health, considering sublethal levels of metals that are currently found in natural waters.