



Facultad de Veterinaria de Kosice



C. O. V. Zamora
C. O. V. León



Instituto de Estudios de Ciencias de la Salud de Castilla y León

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Large spill of mining wastes in Portelo stream (Douro basin, NE Portugal): Impacts on ecosystem integrity

Teixeira A, Geraldes A, Nogueira M, Parada MJ, Pereira E & Fernandes MC

¹CIMO-ESA-IPB – Mountain Research Centre, School of Agriculture, Polytechnic Institute of Bragança,
Apartado 1172, 5301-854 Bragança, Portugal.

amil@ipb.pt

Streams located at Montesinho Natural Park (NE Portugal) have, generally, high biodiversity and an excellent ecological status. However, in this area there are several abandoned mine sites. As a consequence of intense precipitation during December 2009, several millions of cubic meters of wastes were spilled into Portelo stream, a tributary of Rio Sabor (Douro basin). The large amount of wastes covered the riverbed with a layer of fine sediments reaching more than half a meter in areas close to the mine. Both riparian and agricultural areas were also affected by these sediments from the mine. Wastes were spilled downstream until the main watercourse, River Sabor, by several strong rain events. This study, developed from 2010 to 2012, evaluated the impact of this event on ecosystem integrity, namely in the water chemistry, channel and riparian habitats and on macroinvertebrate communities. Samples were collected from eight different stations distributed along the hydric system. Furthermore toxicity experiments were developed in laboratory for one fish species, the barbel (*Luciobarbus bocagei*), an endemic cyprinid present in River Sabor. The results showed a substantial increase of conductivity ($>300 \mu\text{S}\cdot\text{cm}^{-1}$), and total suspended solids ($> 100 \text{ mg}\cdot\text{L}$) and a decrease of pH (<5) in the watercourses. From the 52 elements analyzed, including different heavy metals, it was detected an higher concentration of copper, aluminium and cobalt in the water. Aquatic habitats were severely disturbed and important changes occurred in riparian zone. Concomitantly, temporal and spatial differences were found and several metrics (e.g. taxonomic richness, diversity, evenness) confirmed the disturbance detected on macroinvertebrate assemblages. As expected, the stations located near the mine showed the highest levels of contamination and disturbance. Biochemical indicators (Na^+ and K^+ plasmatic concentrations) used in laboratory tests were sensitive, under acute copper exposure of barbel populations (different copper concentrations, 0.06-0.48 ppm were used), and can help to justify the disappearance and or reduction of fish species in the affected area.

Key-words: Mine spilling, water quality, macro-invertebrates, ecosystem integrity, toxicity tests