PAHs and metals in a Coastal Lagoon (Esmoriz/Paramos), Portugal

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Introduction:

Esmoriz/Paramos is a coastal lagoon on the northwest coast of Portugal with an area of approximately 5.6 km^2 and occasional communication with the sea. This habitat has a great ecological importance due to its fauna and vegetation and constitutes a bird breeding area . For the last 25 years, the wet area of the lagoon has been reduced due to the transport of particles from land through the main tributairies. Pollution sources include untreated sewage water, industrial effluents and run-off from agricultural activities. Dredging the sediments is the strategy planned by the local authorities to restore this ecosystem and improve its recreational value. Thus, evaluation of sediment quality (contamination by polycyclic aromatic hydrocarbons (PAHs) and heavy metals is important for planning disposal purposes.

Materials and Methods:

Water sampling was carried out, monthly for one year, in three different sites within the wet area of the lagoon (Fig. 1). Physico chemical analysis were performed according to methods described in [1].
Sediments cores of 30 cm long and 7 cm diameter were obtained with a Glew corer and fractions of 2 cm depth were split for organic compounds (PAHs) and heavy metal analysis from 6 sampling stations. The 16 EPA priority PAHs and Cu, Zn, Pb, Cr and Ni were quantified in depth according to [2, 3], respectively. Standard reference materials for PAHs and metals were quantified using the same methodology as for the samples.

Fig. 1 - Esmoriz/Paramos Lagoon showing the water, P; Pa; M and sediment sampling stations 1-10.

Results and discussion:

Water

The water analysis carried out in the three different stations within the lagoon, showed a poor quality, namely low percentage of oxygen saturation and high inorganic nitrogen. In September when water temperatures were highest the oxygen saturation was specially low (Fig. 2). Maceda, the southern tributairy presented a peak of ammonia nitrogen in July reaching 7 mg/L, but the annual average was 3 mg/L, whereas in Paramos, the northern tributairy, the peak was earlier in June and the concentrations lower. Ponte, the station near the sea showed a similar pattern of ammonia nitrogen with a peak in June and an average of 2 m/L. These concentrations are above the portuguese limits for superficial waters [4]. Nitrate was the other parameter with high values but its concentrations were similar between the 3 sampling stations, except for a peak in Paramos during May.

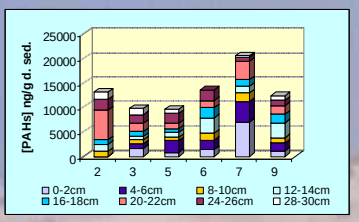

Fig. 3 – Total PAH concentration along depth and sampling stations.

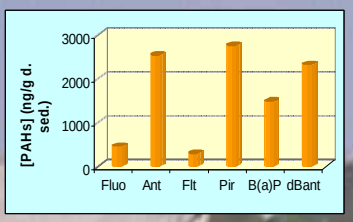

Fig. 4 - PAH profile in station 5 showing the most abundant PAHs in the top 4 cm of sediment.

Fig.2 – Water quality in three sites within the Esmoriz/Paramos Lagoon. Maceda;Paramos and Ponte.

Zinc was the most abundant metal followed by copper and lead and smaller concentrations of chromium and niquel (Fig. 5, 6). Metal variation in sediments was larger between stations than along depth. Therefore an average concentration of metals exposure to living organisms was calculated [6].

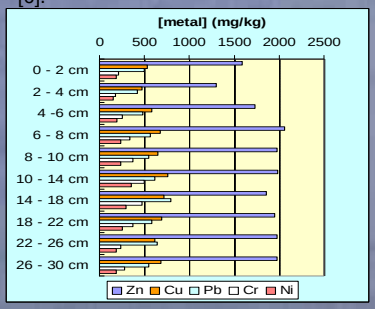

Fig. 5 – Metal concentrations in the sediments along depth.

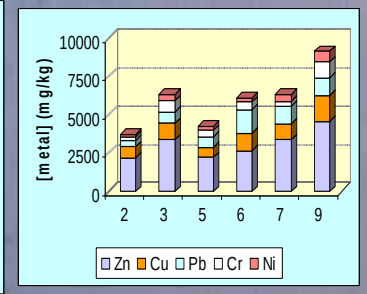

Fig. 6 – Metal distribution in the sampling stations within the lagoon.

Sediments

According to [5] the sediments revealed moderate to high and very high concentrations of PAHs with different patterns of distribution along stations and depth. The most contaminated station (7) reached a total concentration of 20 μg of PAHs g^{-1} of dried sediment (Fig. 3) and the superficial fractions (0-2; 2-4 cm) accounted for 50% of contamination. In the same station 7 the most abundant PAHs in the top 0-4 cm depth were pirene followed by anthracene and dibenzoanthracene representing 25% each of the total (Fig. 4).
In general the most frequent PAHs were fluorene, fluoranthene, pyrene, chrysene and benzo(a)pyrene.

Conclusion:

- ❖ The water quality in the lagoon is poor, specially the oxygen saturation during summer months, ammonia nitrogen and nitrate.
- ❖ Total PAH contamination was moderate to high and very high depending on station and depth.
- ❖ Metal contamination showed the pattern Zn > Cu = Pb > Cr = Ni
- ❖ Organic and metal contamination were not associated since the most contaminated stations did not coincide.

References:

[1] Standard Methods for the Examination of Water and Wastewater, 18th ed. [2] Decreto-Lei n.º 236/98. [3] Kelly, C. A. et al. 2000. CEFAS, Lowestoft. [4] HMSO, 1986. [5] Beaumard, P. et al. 1998. Environ Toxicol Chem 17, 765-776. [6] Fernandes, C. et al. 2007. Ecotoxicol Environ Saf 66, 426-431.