Comparison of sediment risk evaluation and ecological status assessment within the Water Framework Directive

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Introduction: The need to include the monitoring and assessment of sediment contamination is implicit in the Water Framework Directive (WFD) [1]. In this contribution, an integrative assessment of sediment quality in 12 estuaries of the Basque Country (northern Spain) is presented. The aim of this study is to compare the sediment risk evaluation and the ecological status of these water bodies.

Methods: Sediment samples were obtained from 23 locations in the 12 Basque estuaries, between 2004 and 2012 (*Fig. 1*). For each sediment sample, three main sets of information have been considered for the sediment risk evaluation: (i) chemical analyses (Cd, Cr, Cu, Hg, Ni, Pb, Zn, ΣPCB and ΣPAH concentrations); (ii) toxicity tests (using Microtox®, amphipod *Corophium* sp. and sea urchin *Paracentrotus lividus* larvae bioassays); and (iii) benthic status (M-AMBI). In addition, the ecological status for each sample was determined using a 'Decision-tree' assessment, within the WFD [2] to integrate (i) water physico-chemical data; and (ii) multiple biological elements (phytoplankton, macroalgae, benthos and fishes).

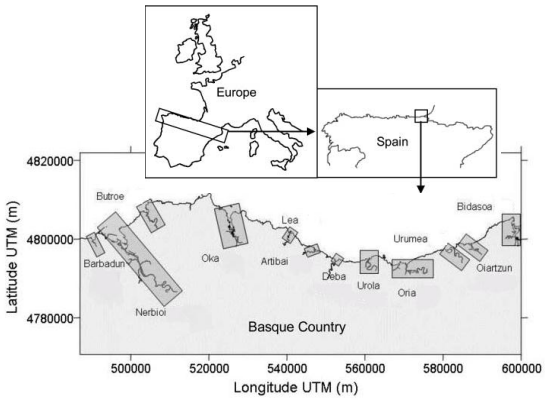

Fig. 1: Map of the Basque Country, showing the estuaries studied.

Results: Metal and organic concentrations in the sediments were, in most of the samples, higher than Threshold Effect Level (TEL) and the Probable Effect Level (PEL) [3, 4] (*Fig. 2*). However, bioassays only revealed medium toxicity in four sampling stations and most of them achieved good benthic status (*Fig. 2*). In addition, more than 80% of the samples classified as with good ecological status corresponded to "no potential risk" sediment samples (*Fig. 3*).

St	MET	ΣPCB	ΣPAH	BEN	TOX	ES	St	MET	ΣPCB	ΣPAH	BEN	TOX	ES
BA5	MC	NC	NC	G	NT	P	D5	HC	NC	MC	H	NT	M
BA10	MC	MC	NC	P	NT	P	D10	HC	MC	MC	G	NT	G
N10	HC	MC	MC	G	NT	P	U5	HC	MC	MC	G	NT	G
N20	HC	MC	MC	H	NT	M	U8	MC	MC	MC	H	NT	G
B5	MC	NC	MC	H	NT	G	U10	MC	MC	MC	G	NT	G
B7	MC	NC	MC	G	NT	G	O5	HC	NC	NC	G	NT	G
B10	MC	NC	NC	G	NT	G	O10	MC	NC	NC	G	NT	M
OK5	MC	NC	NC	G	NT	M	OI10	HC	MC	NC	M	NT	M
OK10	MC	NC	MC	M	NT	M	UR5	HC	MC	MC	P	NT	P
OK20	MC	MC	NC	G	NT	G	UR10	HC	MC	MC	M	NT	P
L5	MC	MC	NC	H	MT	G	BI5	MC	MC	NC	G	NT	M
L10	HC	MC	NC	G	NT	G	BI10	HC	MC	NC	H	MT	G
A5	MC	MC	NC	B	MT	M	BI20	MC	MC	NC	G	NT	G
A10	HC	MC	MC	M	MT	B							

Fig. 2: Sediment quality assessment for the Basque Country estuaries. St: station; MET: Metals;; BEN: Benthos; TOX: Toxicity; ES: Ecological status (High, H; Good, G; Moderate, M; Poor, P; Bad, B). HC: high contamination; MC/MT: medium contamination or toxicity; NC/NT: no contamination or no toxicity;

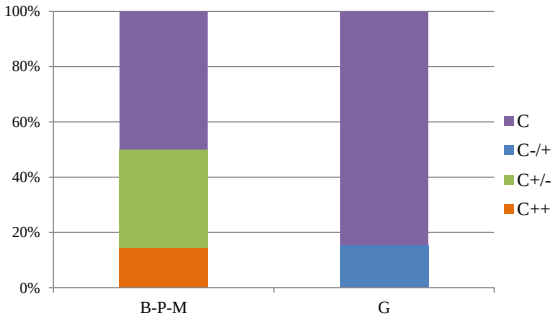

Fig. 3: Percentage of samples according to the sediment risk assessment in relation to the ecological status classification, defined by Bad-Poor-Moderate (B-P-M) or Good (G); No risk: C (contamination); Moderate risk: C-/+ (Toxicity) and C+/- (Benthic alteration); High risk: C++.

Discussion: These results indicate that at some locations the sediments still present high levels of contaminants, but they are not necessarily causing ecological damage (and risk). Thus, the use of chemical and biological assessment in sediments, together with ecotoxicological approaches within the WFD, might assist in a more accurate ecological status assessment of water bodies [5].

References: [1] Directive 2008/105/EC; [2] Borja et al. (2009) Marine Pollution Bulletin **59** (1-3): 54-64; [3] Menchaca et al. (2012) Chemistry and Ecology **28** (3): 205-220; [4] Buchman (1999) NOAA HAZMAT Report 99; [5] Borja et al. (2008) Marine Pollution Bulletin **56**: 1519-1537.