

Physico-chemical and ecotoxicological evaluation of the Rovinj costal area sediments, NE Adriatic Sea, Croatia

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Introduction: Spatial and temporal data on sediment quality in Croatia, regarding major groups of contaminants like heavy metals, PAHs and PCBs are missing. There is an urgent need that the environmental authorities define limits for contaminants in sediments for different use of marine resources at national level.

The aim of this study was to characterize physico-chemical and ecotoxicological properties of marine sediments in the local Rovinj costal area as pilot project. The values were compared with regional averages and suitable French sediment quality criteria regulation, as Croatia and France are both Mediterranean countries with intensive aquaculture, tourism and traffic activities [1].

Methods: We collected sediment at 5 locations in Rovinj costal area according to different human activities and impacts: Local harbour (S1), Shipyard (S2), Lim Bay out, traffic (S3), Lim Bay middle (S4) as mariculture site, and Open sea 3NM in front of Rovinj as reference-control site (S5).

Sediment granulometry, PAHs and PCBs analyses and heavy metals content were performed according to the standard protocols [2]. Phytotoxicity testing of sediment eluates (4 g; 1:10, dried sediment/water) was conducted with 5 ml at 25°C over 72 h test period using seeds of flax *Linum usitatissimum* as previously described [3]. To estimate the probability of a toxic effect we have applied logistic regression models as described [4]. The comparison with French regulatory management of contaminated sediments based on two levels (N1 and N2) of contaminant concentrations in the whole sediment was done by QN1 = sum ratios between contaminant concentration / legal level (N1) [3].

Results: Results of chemical analyses (heavy metals, ΣPAHs, ΣPCBs) were compared with French marine sediment quality regulations. Several contaminants were present at higher concentrations than N1 level (Cu, Ni, Hg, Cr and ΣPAHs) and few have values close to N1 (As, Pb and ΣPCBs). Except S1 (Hg) there are no sediments with higher N2 legal level. Probability of a toxic effect discriminate investigated sites according the contamination level determined by chemical analyses also.

Phytotoxicity assay showed inhibition of germination, root length and root biomass production. All three parameters indicate similar results and allowed calculation of Germination index: S1) 65.1%, S2) 62.7%, S3) 56.5%, S4) 84.2%, using S5 as a control pristine area sediment (100%).

Table 1: Results of sediments Chemical analyses, French contamination evaluation (QN1) and Probability of toxic effects (Pavg, Pmax).

Parameters (units)	Sampling sites					N1 Legal level	N2 Legal level
	S1	S2	S3	S4	S5		
Fine particle (<63 µm; %)	19,6	45,1	94,3	95,0	16,3	-	-
As / (mg kg ⁻¹ d.m.)	9,223	23,440	8,126	13,850	3,985	25	50
Cd / (mg kg ⁻¹ d.m.)	0,265	0,092	0,083	0,091	0,073	1,2	2,4
Cu / (mg kg ⁻¹ d.m.)	69,95	30,59	13,77	18,45	4,77	45	90
Ni / (mg kg ⁻¹ d.m.)	7,93	14,15	28,59	41,16	8,49	37	74
Pb / (mg kg ⁻¹ d.m.)	24,38	6,95	1,83	1,35	3,69	100	200
Zn / (mg kg ⁻¹ d.m.)	115,60	50,66	71,75	88,00	31,87	276	552
Hg / (mg kg ⁻¹ d.m.)	0,838	0,266	0,129	0,138	0,038	0,4	0,8
Cr / (mg kg ⁻¹ d.m.)	22,49	26,31	76,11	98,14	22,39	90	180
ΣPAHs / (mg kg ⁻¹ d.m.)	10,609	9,867	4,555	0,028	0,103	1,50	15
ΣPCBs / (mg kg ⁻¹ d.m.)	0,278	0,170	0,058	0,021	<0,010	0,50	1
QN1	10,72	7,26	3,04	2,20	0,00	-	-
Pavg	0,81	0,73	0,62	0,24	0,18	-	-
Pmax	0,51	0,48	0,47	0,35	0,15	-	-

Yellow colored values are higher than level N1 Legal level;

Discussion: All performed analyses sort our sites S4 and S5 as pristine areas. PCBs concentrations detected in recent surface sediments in this study present a significant decrease in comparison to those previously detected in northern and middle Adriatic 0.9-14.7 mg/kg d.m. [5].

Correlations of Pavg and Pmax values with other measured parameters were established: QN1 level (0.88; 0.80), ΣPAHs (0.96; 0.81), ΣPCBs (0.87; 0.72), and Phytotoxicity (0.89; 0.95).

By application of suitable French sediment quality guidelines (QN1) and Pmax/Pavg probability of a toxic effect it was possible to rank investigated sites according the increasing contamination level (S5>S4>S3>S2>S1). In general, according French sediments quality regulations there is no potential ecological impacts on the aquatic environment at all investigated areas.

References: [1] Roper H. and Netzband A. (2011) Hamburg Port Authority; [2] Linšak et al. (2012) *Coll. Antropol.* **36**:1401–1405; [3] Mamandy-Pajany et al. (2010) *Chemosphere* **82**:362-369; [4] Field et al. (2002) *Environ. Tox. Chem.* **21**:1993-2005; [5] Fowler et al. (2000) Ecosystem Research Report No. 32, US Department of Energy.