Organic pollutants and functional properties of benthic microbial communities in coastal lagoons (River Po delta)

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Introduction: The sediment is a compartment of fundamental importance in the aquatic ecosystem by acting as a sink or source of organic matter, including pollutants, and nutrients. Benthic heterotrophic microorganisms are posed at the base of the heterotrophic food chain and play an important role in the biodegradation processes and ecosystem functions. Information regarding possible links between organic pollutants contamination and processes mediated by microbial communities are still lacking. Moreover for the establishment of environmental quality standards (EQS) the sediment compartment is not necessarily monitored although threshold values are given for priority organic substances by the European water Framework Directive (2013/39/UE). To fulfill this gap, in the framework of the Project RITMARE funded by the Italian Ministry of University and Scientific Research, a sampling survey was conducted (May, 2016) in coastal lagoons sited along the River Po river in the northern Adriatic Sea. These fragile systems receive nutrients and contaminants transported by the River Po, one of the most important contributor of organic matter and nutrients to the Mediterranean Sea. Such high loads may pose a substantial ecotoxicological risk, that is of particular concern considering their exploitation for clam farming.

Methods: A total of 12 sampling stations were selected in the lagoons Caleri, Marinetta-Vallona, Canarin, Scardovari (**Fig. 1**). Surface sediments were analyzed to measure the concentrations of the proteins (PRT), lipids (LIP) and carbohydrates (CHO)[1 and ref. therein] along with organic carbon (OC%) and stable isotope of organic carbon ($\delta^{13}C$) [2]. The quality of sediments was then described by the analysis of organic pollutants of environmental concern (Polycyclic Aromatic Hydrocarbons, PAHs, nonylphenol, NP, and Bisphenol A, BPA) [3]. Benthic microbial properties were described by bacterial cell abundances (BAB, DAPI stain), Bacterial C Production rate (BCP, ^{3}H-leucine inc.), community respiration rates (CR, Electron Transport System), extracellular enzyme activities (EEA, lipase, aminopetidase, beta-glucosidase activities,) [4].

Fig. 1: Sampling sites along the River Po delta

Results: Overall, the lagoons showed moderate pollution by organic pollutants. None of PAH congeners exceeded the set quality standards, whereas NP concentration exceeded the Predicted No-Effect Concentrations (PNEC) for sediments (39 ng/g) indicated by the European Directives, in the Marinetta, Canarin and Scardovari lagoons. The lagoon Canarin, that receives freshwater from the primary branch of the Po River, showed the highest values of organic pollutants (ΣPAHs 100±10ng/g; BPA 30±13ng/g; NP 96±15ng/g). Moreover the analysis of the Principal Components (PCA), based on the correlation matrix of the variables, showed that the sediments from the Canarin lagoon were characterized by low salinity values, the highest contribution of OC%, the lightest $\delta^{13}C$ values along with the highest EEA rates, BCP rates and the highest BCP/CR ratios.

Discussion: Changes observed in the sediment characteristics imply adaptations in the metabolic properties of the microbial communities with potential repercussions in the fate of the organic matter (energy transfer to trophic chain or oxidative processes with CO_2 emission). These results suggest a closer look at the links between organic pollutants and microbial metabolism and improve the current environmental quality assessments.

References: [1] Franzo A, et al. (2016) *Cont Shelf Res* **121**: 35-47 [2] Tesi et al. (2007). *Est Coast. Shelf Sc* **73**: 431-446 [3] Patrolecco et al. (2010) *Chemosphere*, 81:1386-1392. [4] Zoppini et al. (2016) *Sc Tot Environ* **541**:1364-1371.