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

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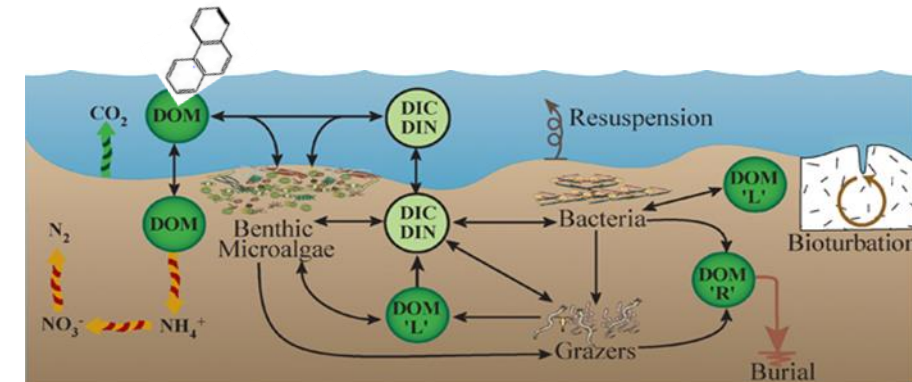
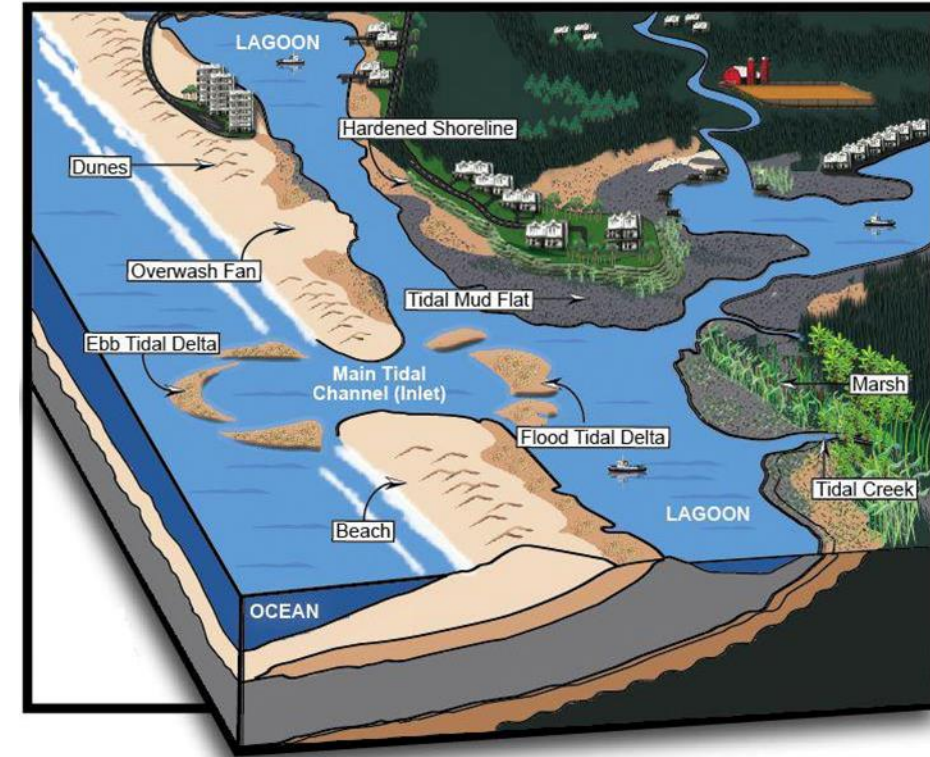
Zoppini A., Ademollo N., Amalfitano S., Cibic T., Melita M., Patrolecco L., Zonta R.

[zoppini@irsa.cnr.it](mailto:zoppini@irsa.cnr.it)



# Background

- River delta are transitional environments between land and sea, created by the deposition of the river sediment
- These aquatic system are very productive and act as sink or source of organic matter and nutrients, able to influence coastal waters and to support ecosystem services.
- Contaminants from anthropogenic origin, entering these systems may sink and some of them easily sorbed to sediment particles
- To establish Environmental Quality Standard (EQS), threshold values are given for priority organic substances (WFD 2013/39/EU) and Crustaceans, Molluscs and Fishes are monitored.
- Microbial communities are not considered although posed at the base of the heterotrophic food web with important role in the biogeochemical processes and ability to remove organic pollutants.



# The Goal

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**“To describe the relationships occurring between the concentration of selected organic pollutants of environmental concern and microbial processes, utilising *in situ* observations on coastal lagoons”**

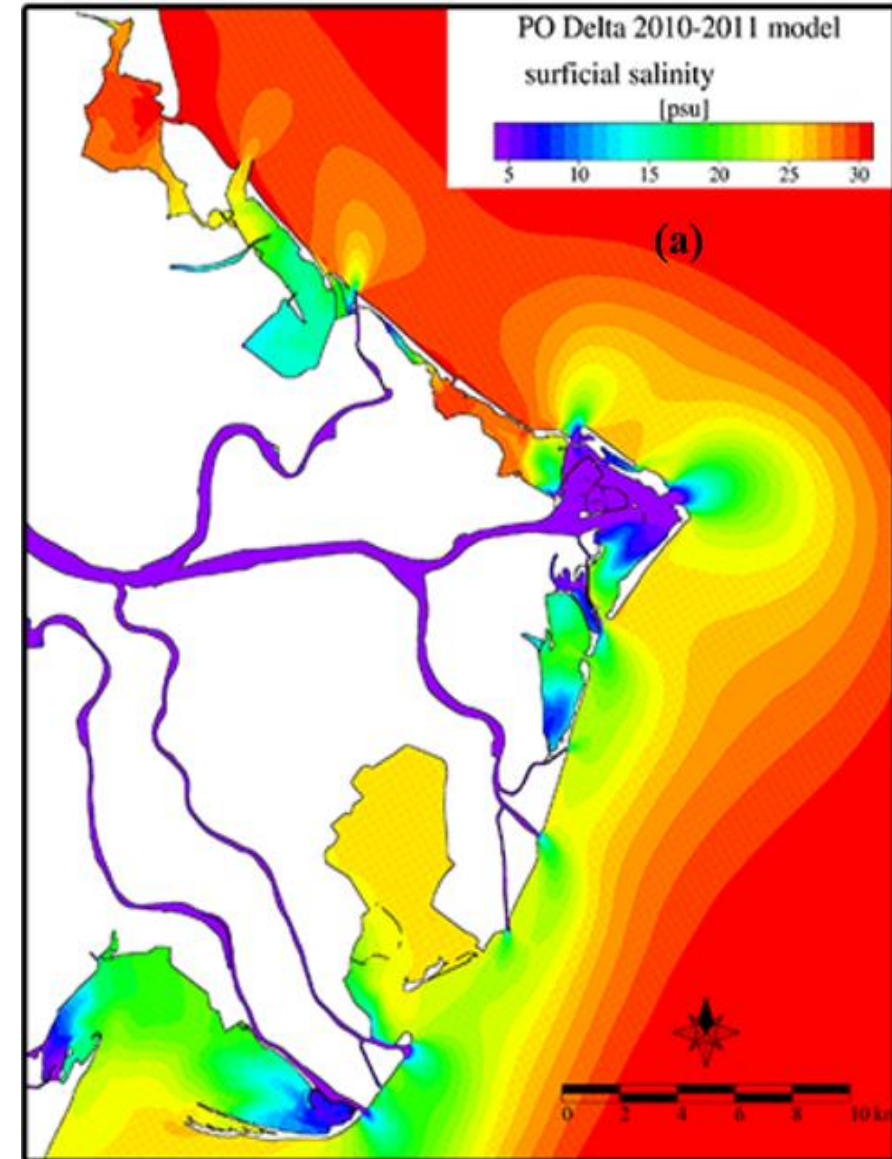


# The sampling site

The lagoons considered in this study are in the Regional Park of the Po river Delta, sited in North-eastern Italy



- Po river average flow  $1490 \text{ m}^3 \text{ s}^{-1}$
- Delta area  $650 \text{ km}^2$
- 6 fluvial branches (total 160 km)
- 7 lagoons (total area  $105 \text{ km}^2$ )
- Lagoon mean depth 1.4 m
- Lagoon water turnover time 2-10 days (peaks of 30 d)



Salinity, years 2010-2011 (Maicu et al. 2017, in prep.)

# Selected contaminants

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## Organic Priority Substances , WFD 2013/39/EU:

- **Polycyclic Aromatic Hydrocarbons (PAHs)** are ubiquitous and deriving from pyrogenic and petrogenic sources. These contaminants are toxic, bioaccumulative with high affinity to sediments.
- **Nonylphenols (NPs)** and its precursors (**NPEO2 and NPEO1**) are non-ionic surfactants used in industrial, domestic and commercial applications (see pesticides). They can elicit an estrogenic action against the reproductive system of aquatic organisms.

## Organic substances of environmental concern

- **Bisphenol A (BPA)** is a carbon-based synthetic compound, poorly soluble in water. It is employed to make a variety of common consumer plastic goods. It exhibits hormone-like properties. The BPA utilization is banned for the manufacture of polycarbonate infant feeding bottles (Directive 2011/78/EU) and reduced in toys (Directive 2014/81/EU).

The sampling survey was conducted (May 2016) on four lagoons (12 sites), on surface sediments (-2cm) sampled by box corer

## Chemical composition

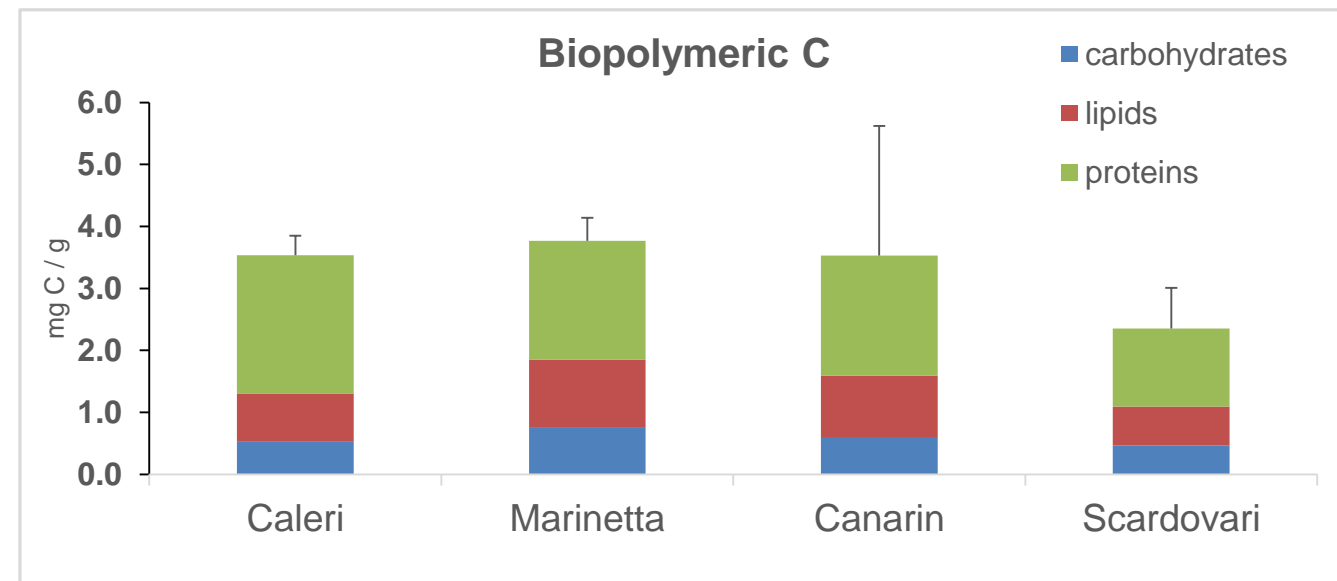
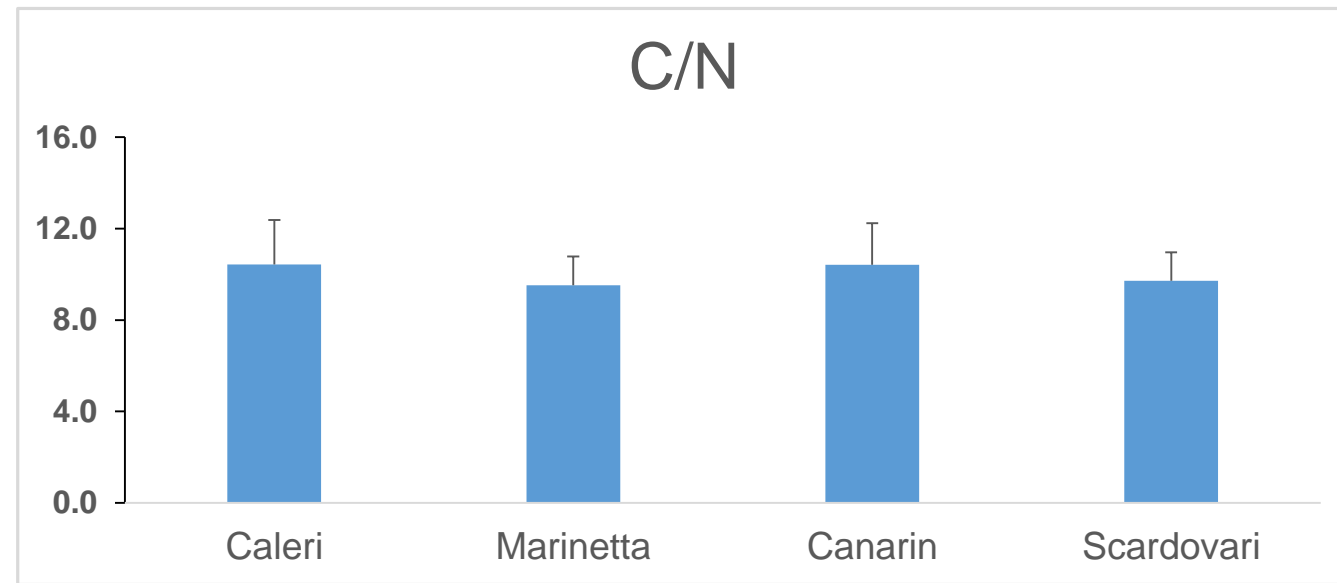
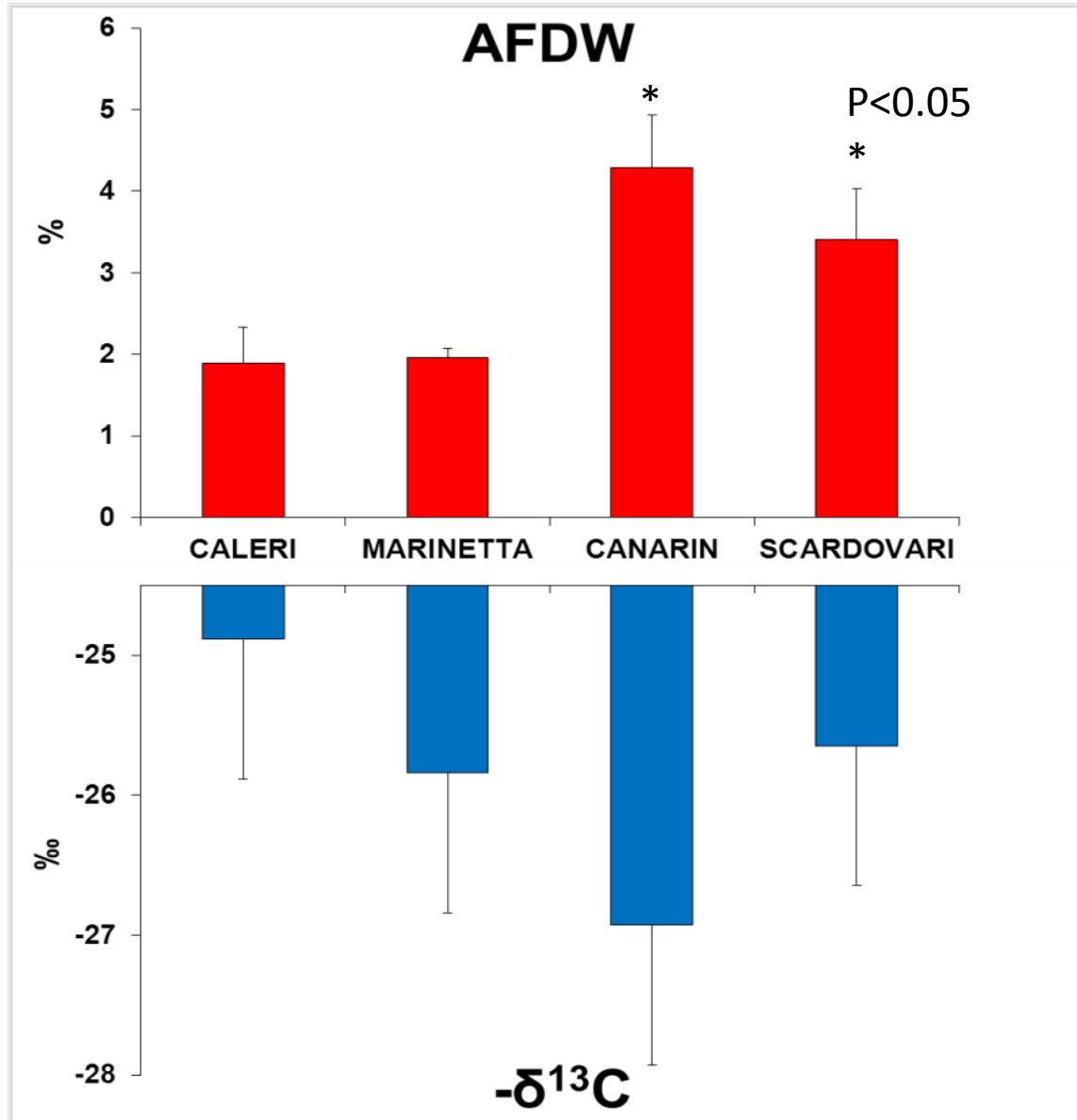
- Organic C, nitrogen (TOC and TN; CHN analyser), AFDW (500°C)
- Organic C stable isotope analysis ( $\delta^{13}\text{C}$ ; mass spectrometer)
- Biopolimeric-C (protein, lipids, carbohydrates, spettrofotometry)
- Pollutants: Polycyclic Aromatic Hydrocarbons (15 congeners,  $\Sigma\text{PAHs}$ ), nonylphenols,  $\Sigma\text{NPs}$  (NPs, 4NP) and its ethossilates (NP1EO, NP2EO), Bisphenol A (**BPA**) (LC/MS-MS and HPLC/UV-fluorescence)

## Microbial communities properties

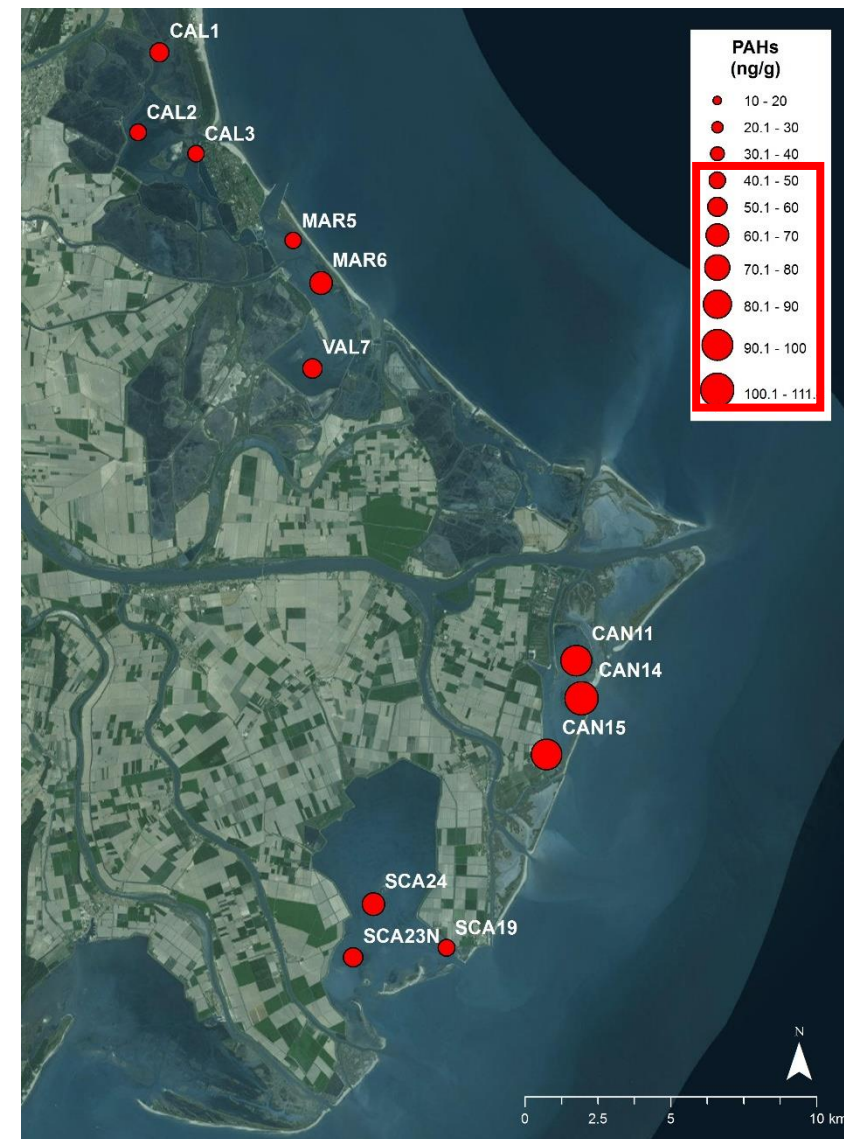
- Prokaryotic cell abundance (PAb, DAPI; epifluorescence microscopy)
- Prokaryotic C Production rates (PCP,  $^3\text{H}$ -leucine incorporation)
- Community respiration rates (CR, Electron Transport System; spettrofotometry)
- Extracellular enzyme activities (Lipase,  $\beta$ -glucosidase, aminopeptidase; fluorimetry)



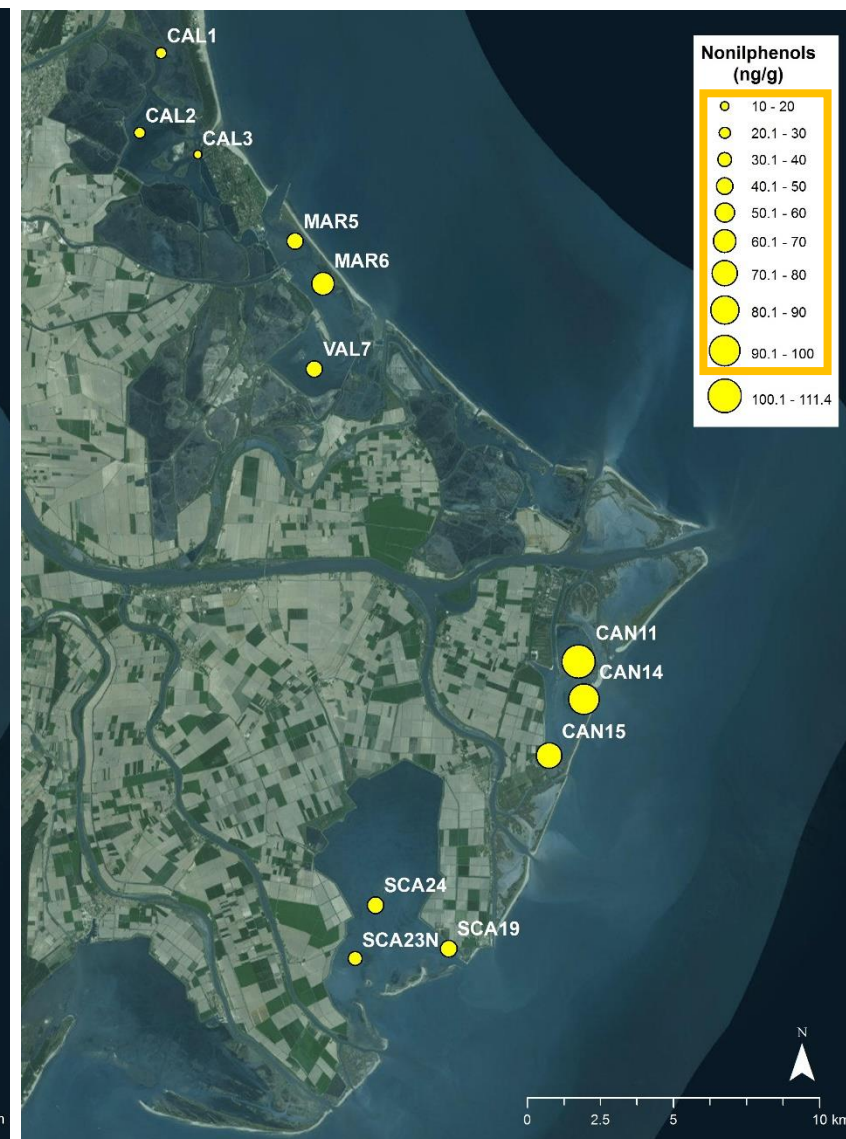
# Results: chemical composition



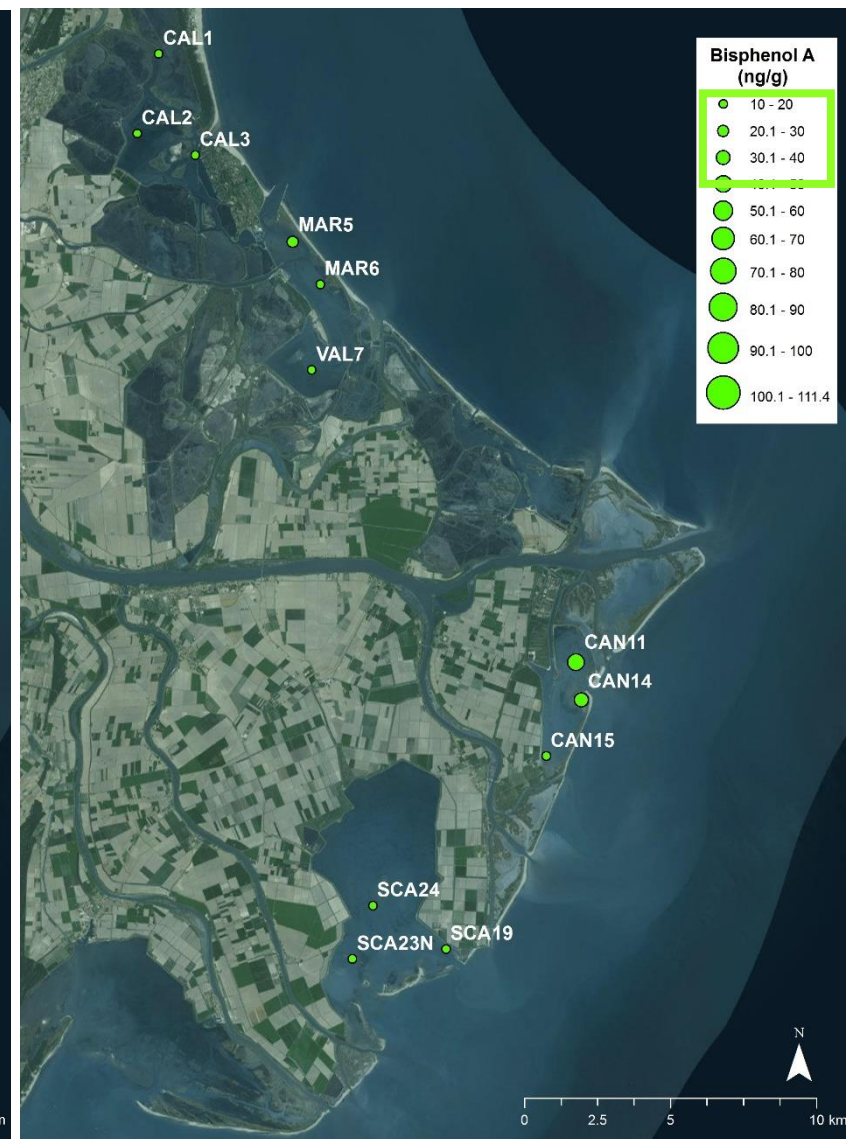
# Results: organic pollutants



ΣPAHs



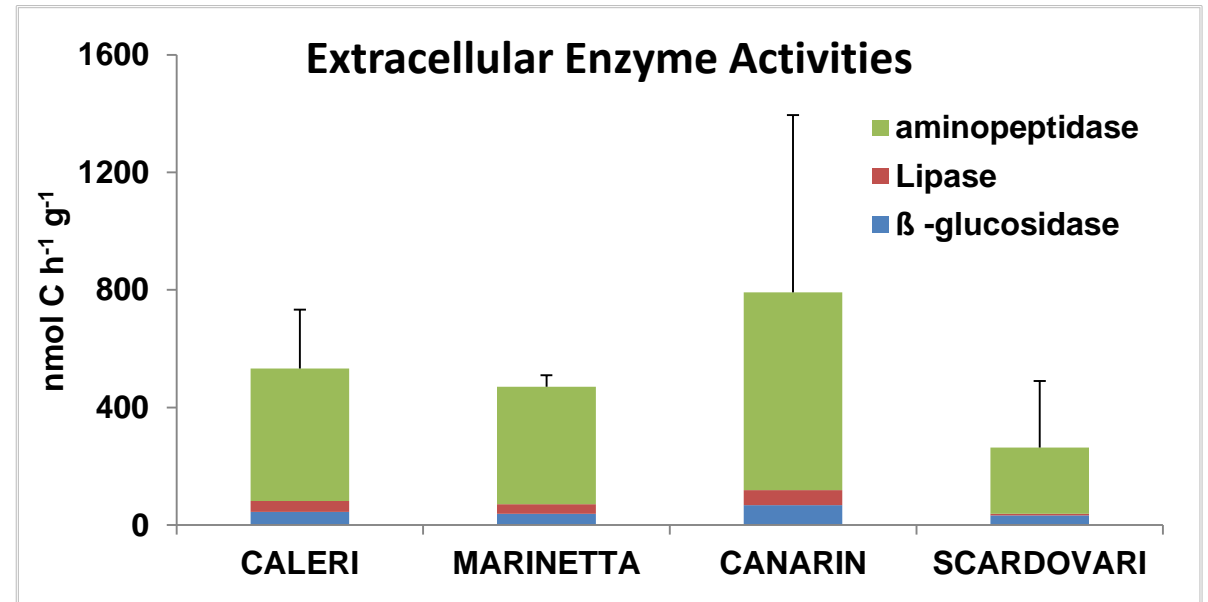
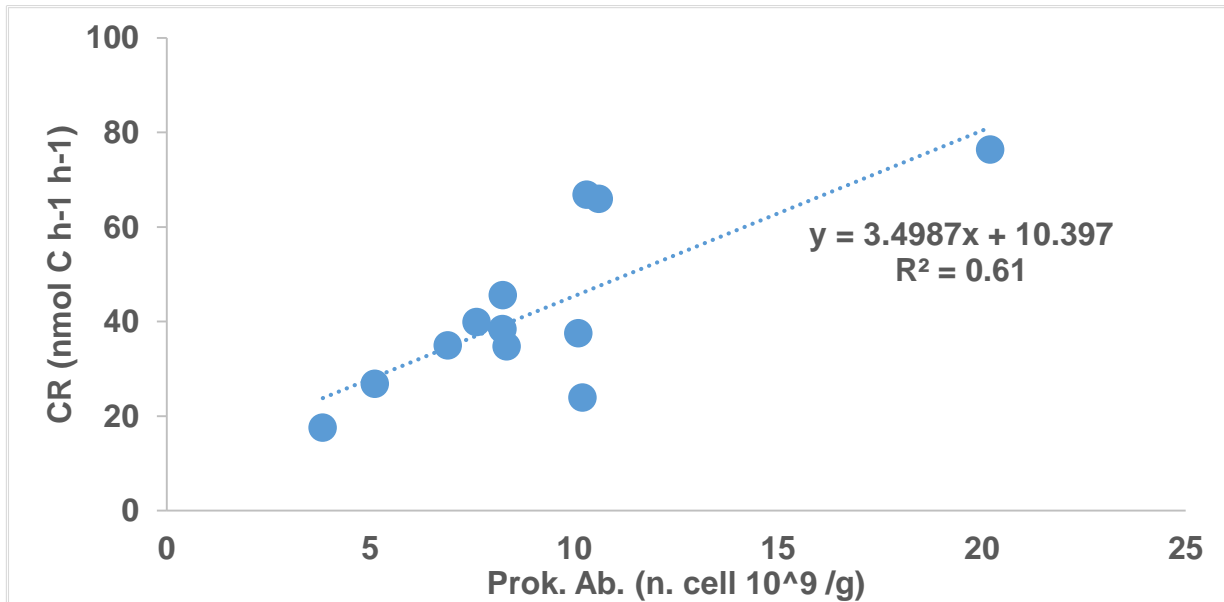
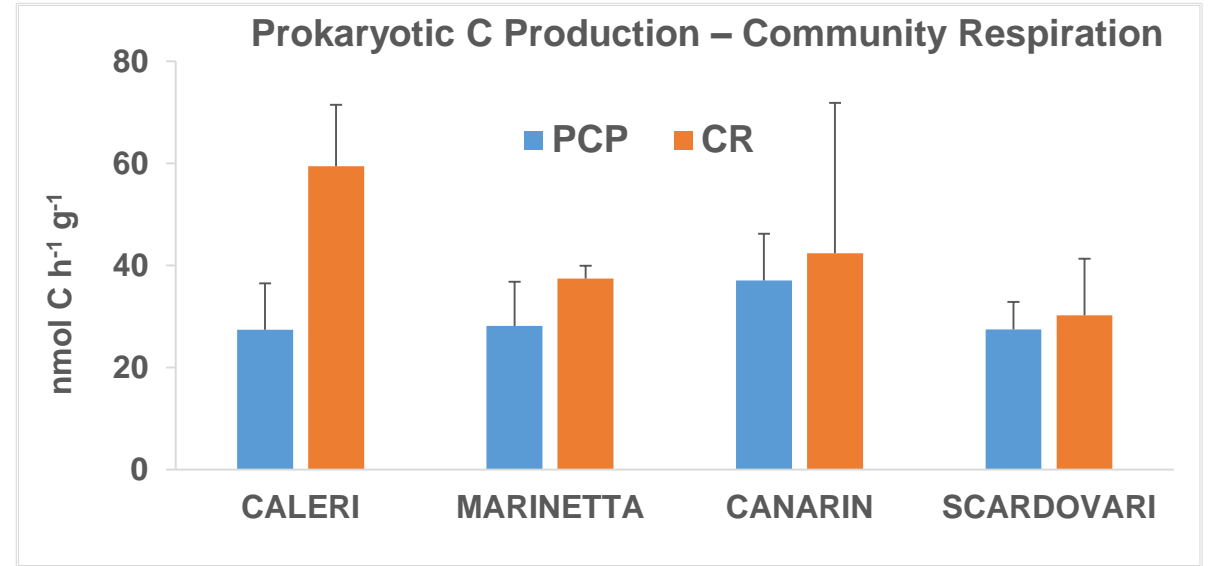
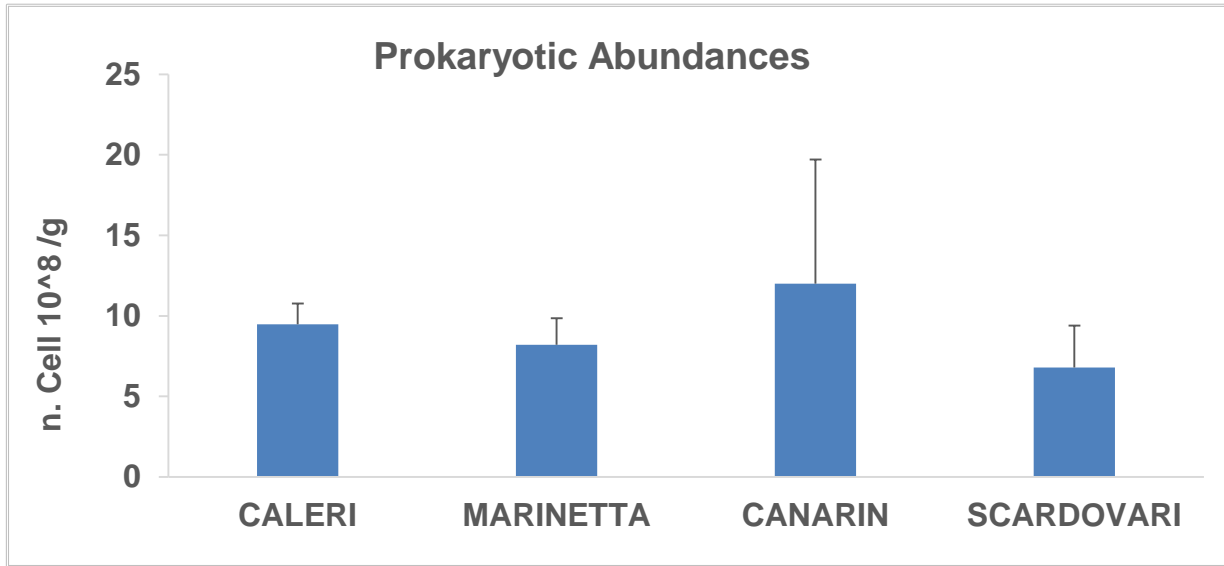
ΣNPs



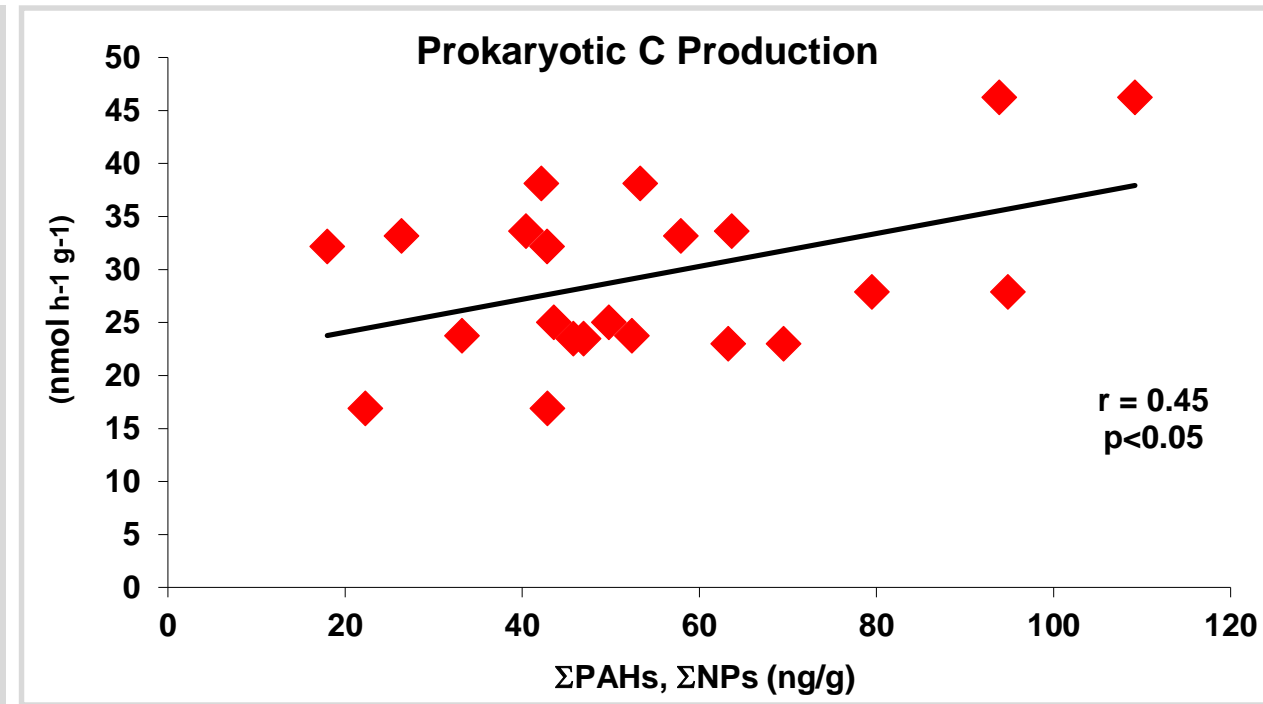
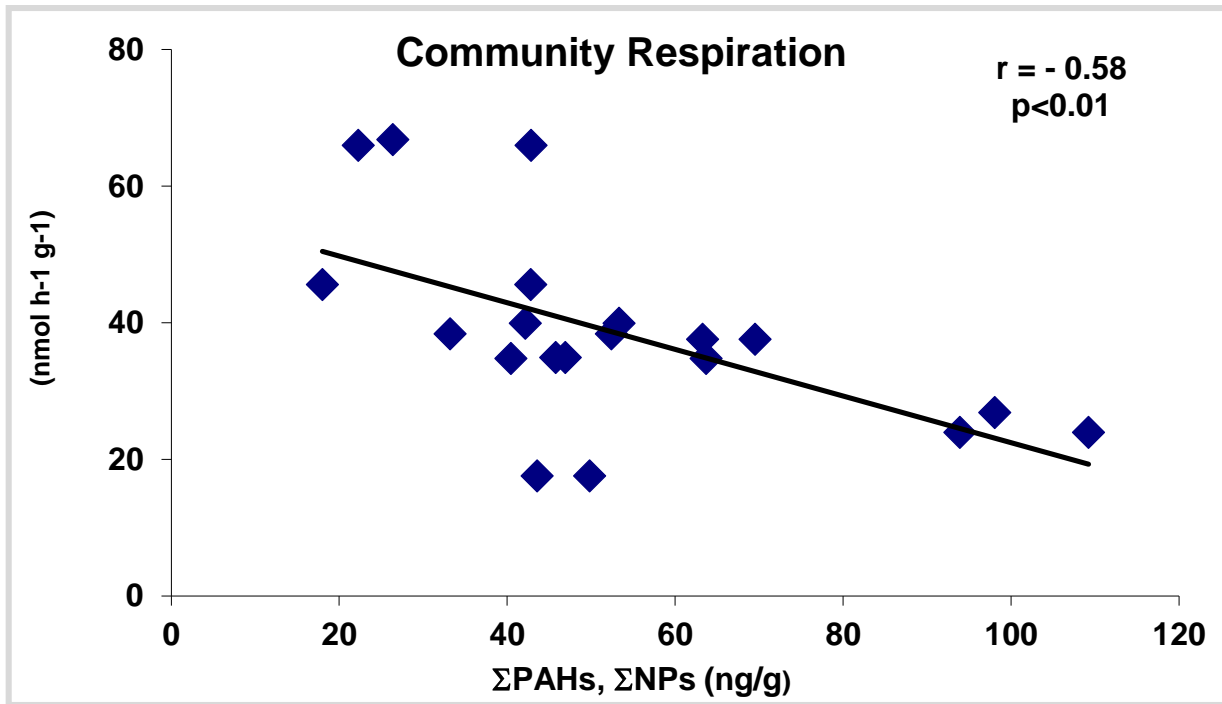
BPA



# Results: microbial properties

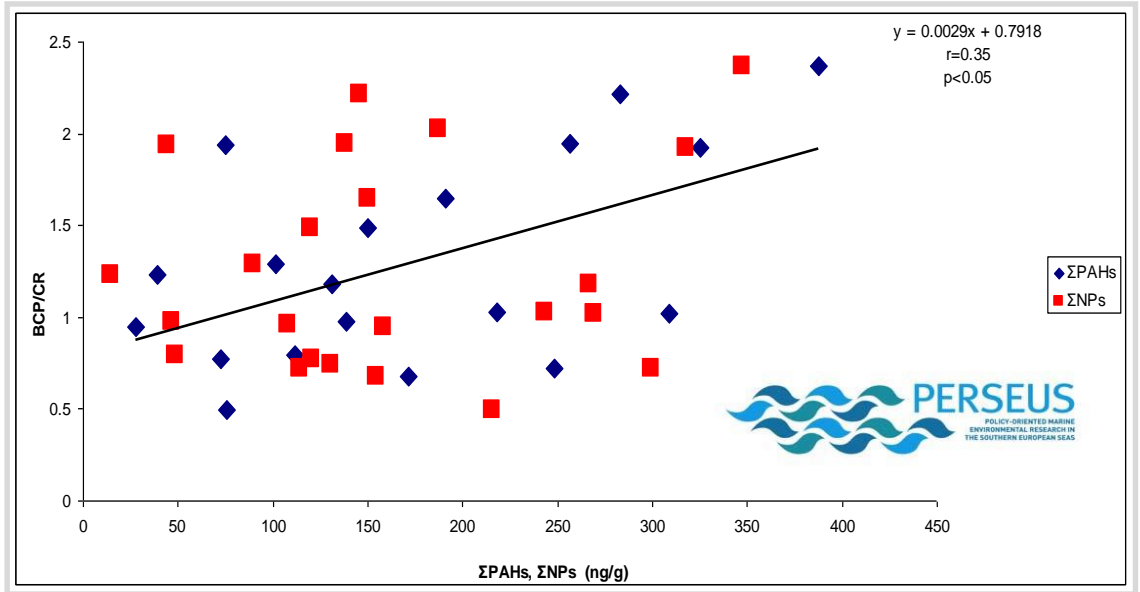
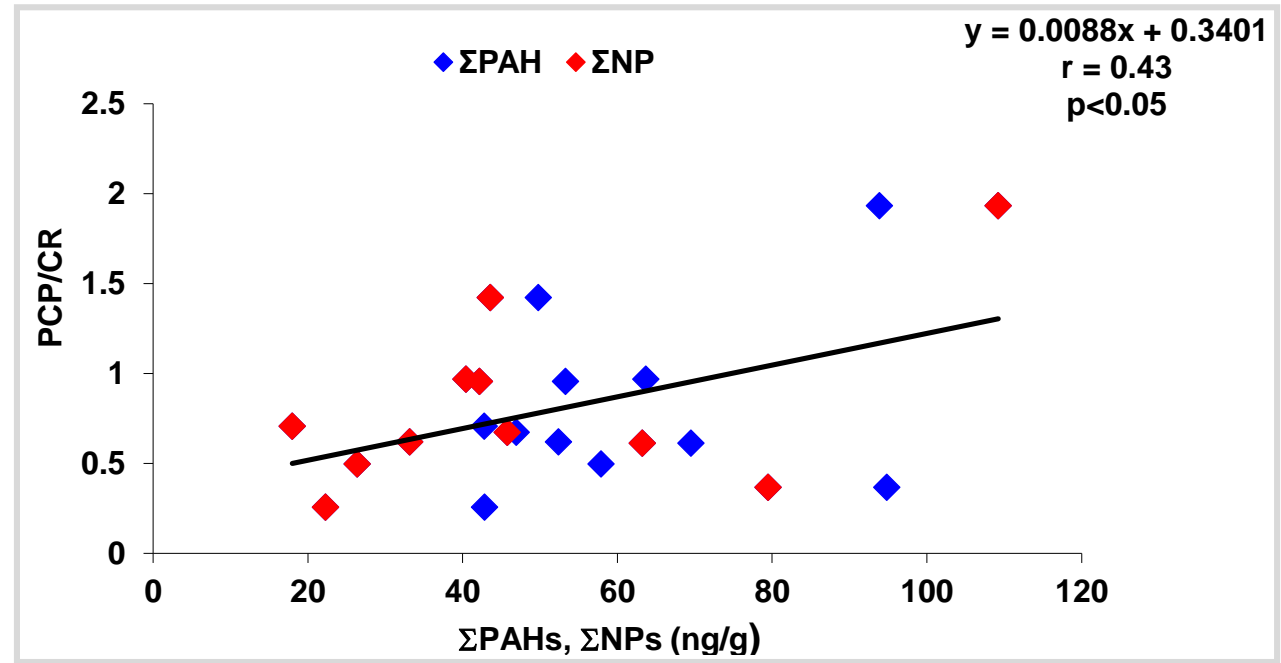


# Results: microbial properties and contaminants



Prokaryotic Ab. Vs ΣPAHs, NPs conc.  $P > 0.05$

# Results: microbial properties and pollutant contamination



Zoppini et al in prep.

Science of the Total Environment 541 (2016) 1364–1371

Contents lists available at ScienceDirect

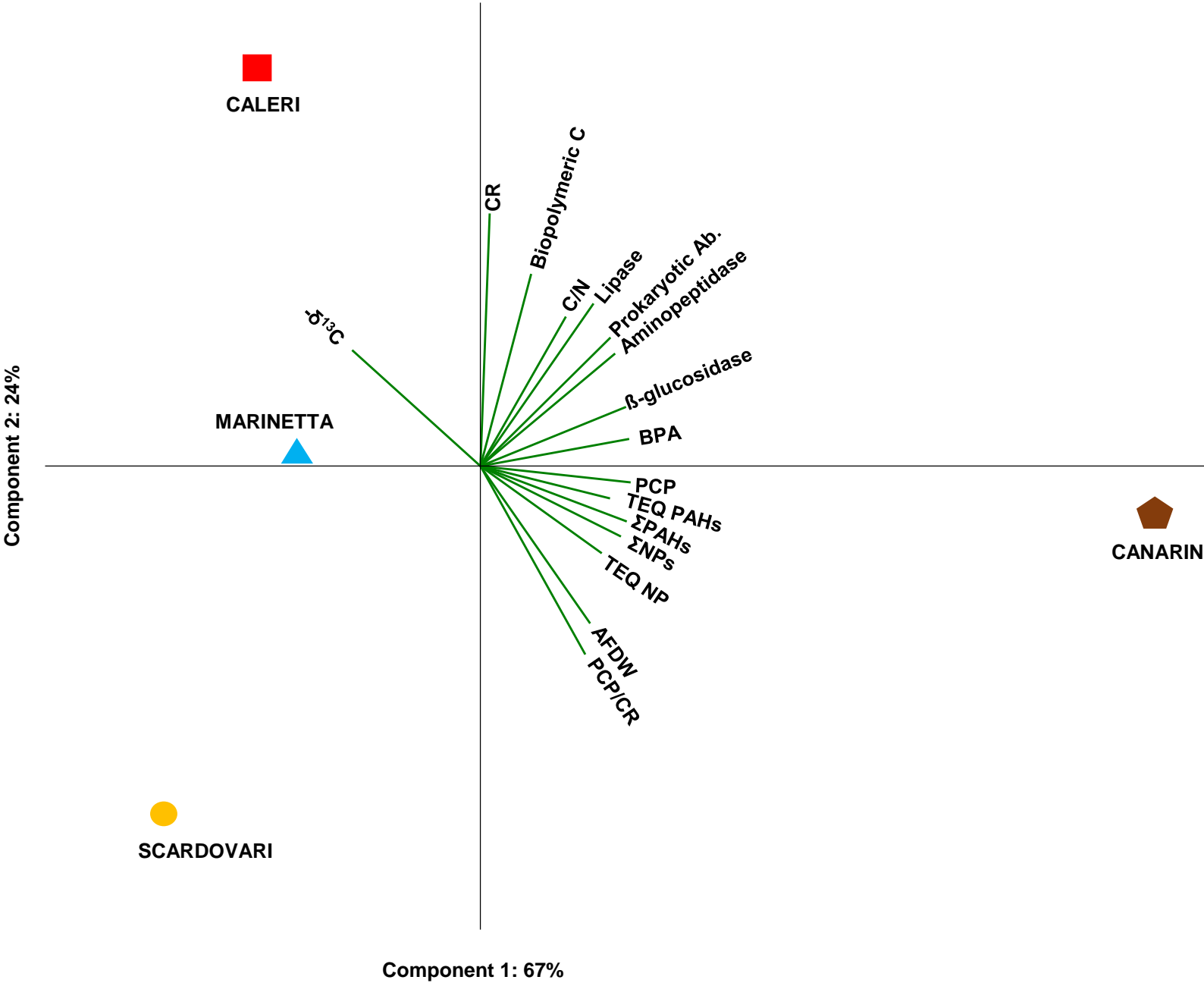
Science of the Total Environment

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Microbial responses to polycyclic aromatic hydrocarbon contamination in temporary river sediments: Experimental insights

Annamaria Zoppini <sup>a,\*</sup>, Nicoletta Ademollo <sup>a</sup>, Stefano Amalfitano <sup>a</sup>, Silvio Capri <sup>a</sup>, Patrizia Casella <sup>a</sup>, Stefano Fazi <sup>a</sup>, Juergen Marxsen <sup>b</sup>, Luisa Patrolecco <sup>a</sup>

# Results: PCA analysis



# Preliminary conclusions

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- The results obtained in this survey, contribute to better define the Environmental Quality Standard, filling the gap on changes of biogeochemical processes mediated by microbial communities.
- The different origine of the organic matter induced changes in the microbial functional profiles.
- Increasing concentration of organic pollutants induced shifts in the Production / Respiration ratio (PCP/CR) toward production processes, without affecting significantly the number of prokaryotic abundance (biomass). This trend confirms previous experimental evidences (e.g. Zoppini *et al.* 2016).
- Different OM sources may have developed different microbial communities with different ability in processing the organic matter sources. Further analyses are still running to detect functional target genes devoted to the degradation of PAHs.
- Changes in the functional properties imply differences in the circulation rates of the OM whose potential implications for the ecosystem productivity has to be investigated by further analyses.

# Thanks !

