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The effect of drying on bed-sediment microbial communities in Mediterranean temporary waters.

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The hydrology of temporary Mediterranean streams is very complex mainly due to the wide and rapid variations in discharge, the importance of transmission losses, the patchiness of bed sediments with different chemical-physical characteristics and the high variability in the succession of wet and dry periods.

In these environments, during no-flow periods, chemical-physical and biological processes are restricted to the benthic compartment and the first flood carries high loads of suspended matter affecting the quality of downstream water bodies. In this context it is crucial to better understand the functional role of sediments exposed to variable climatic conditions; this is one of the major goals of the EU-project TempQsim.

Bacterial degradation and transformation of particulate and dissolved organic matter are key processes with regard to the functional characteristics of river sediments. Bacterial metabolism is strongly related to the water availability that affects the osmotic status of the cells. Periods of moisture limitation may elicit a strong selective pressure on the structure and the functioning of sediment bacterial communities, inducing starvation and resource competition. Sediment water content is hence considered a crucial factor to preserve characteristics and activity of microbial communities.

In this study microcosms experiments were set up to test the effect of decreasing water content on bacterial physiology and to estimate the relevance of biological activity in sediments during drought periods. Sediment samples were collected in four temporary rivers (Krathis river - Greece; Pardiela stream - Portugal; Tagliamento and Mulargia rivers - Italy) from the uppermost-oxidized zone, sieved (2mm mesh) and analyzed for chemical composition and grain size distribution. Initial water humidity was adjusted

to 100% of the water holding capacity; eight microcosms were set-up and stored at a constant 20˚C temperature to follow the variation of microbial activity as a function of the drying process. The bacterial physiological responses were assessed by measuring i) total abundance by DAPI counts; ii) bacterial carbon production by ^{3}H-leucine incorporation; iii) potential free extracellular enzyme activities by the addition of model substrates containing fluorescing agent; iv) community composition by Fluorescent In Situ Hybridization.

In spite of differences in grain size distribution, all tested sediments appeared to be very similar in chemical composition and biological characteristics although i) the community structure differed among rivers in β-*Proteobacteria* relative percentage; ii) a significant difference in alkaline phosphatase denoted a higher P availability in Pardiela stream.

Microbial activities were affected by changes in moisture content. The rates of C production decreased in time, completely ceasing in dried sediments. This decrease was not followed by a proportional reduction in bacterial cells abundance. Most of the extracellular enzymatic activity rates appeared to be independent from sediment water content although a significant decrease has been observed in the aminopeptidase. FISH analysis showed that the percentage of detected *Bacteria* (EUB338) was strongly related to cells activity.

The overall physiological responses of the bacterial communities to water stress conditions appeared to be independent from sediment origin and it was possible to formulate a hypothetical equation linking the rate of bacterial C uptake to the water humidity. This could be helpful for modelling bacterial activity as a function of sediment water content.