

Title: Radial oxygen loss by *Vallisneria spiralis* affects microbial diversity and activity and pore water chemistry in organic sediments.

Submerged macrophytes provide a wide range of ecosystem services including sediment retention, reduction of nutrient recycling, nutrient loss and improvement of pore water chemistry. The latter depends on direct uptake of solutes and radial oxygen loss (ROL), increasing the volume of sediments where aerobic microbial metabolism is allowed. ROL is regulated by multiple factors among which the organic matter content of sediments and the plasticity of macrophytes, specifically their response to chemical reduced conditions. By actively increasing aerenchyma macrophytes can enhance ROL and contrast potential sediment toxicity. In this work the effects of ROL by *Vallisneria spiralis* in organic sediments was tested, focusing on N-related microbial communities, potential nitrification and denitrification and pore-water chemistry. To this purpose, control and organic-enriched (21% VS 9%) vegetated and unvegetated microcosms were realized, acclimatized under control conditions and then characterized.

Results suggest that ROL by *V. spiralis* significantly modified the composition of the microbial community and stimulated aerobic nitrification both in control and organic enriched sediments. They also suggest that ROL and the macrophyte uptake significantly decreased the pore water nutrient concentrations, at least 5-fold. *V. spiralis* increases the oxic subsurface sediment volume where aerobic microbes can grow, thereby favoring the oxidation of reduced end metabolites and the assimilation of nutrients, decreasing concentration gradients and fluxes to the water column. Due to its easy transplant, plasticity and adaptive capacity to grow in organic sediments *V. spiralis* represents an interesting option as nature-based solution to contrast eutrophication.