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Benthic metabolism and denitrification in a river reach: a comparison between vegetated and bare sediments

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ABSTRACT

This study aims at comparing biogeochemical processes in a Vallisneria spiralis *meadow and in unvegetated sediments in the upper reach of the Mincio River (Northern Italy). The main hypothesis of this work is that meadows of rooted macrophytes affect benthic metabolism, enhancing capacity to retain nutrients (assimilation) and dissipate (denitrification) nitrogen loadings. In order to highlight how plants affect benthic processes in the riverbed, oxygen, dissolved inorganic carbon (DIC), soluble reactive phosphorus (SRP) and inorganic nitrogen fluxes, together with denitrification rates, were measured from February to November 2007 in intact cores collected from stands of* V. spiralis *and bare sediments.* V. spiralis *biomass, elemental composition and growth rates were concurrently measured. Macrophyte biomass ranged from 60 to 120 g* m^{-2} *(as dry matter); growth rates followed a seasonal pattern from 0.001 in winter up to 0.080* d^{-1} *in summer. On an annual basis, the macrophyte meadow was autotrophic with net* O_2 *production and dissolved inorganic carbon uptake, while the bare sediment was net heterotrophic. The concurrent N assimilation by macrophytes and losses through denitrification led to similar N uptake/dissipation rates, up to 2500 mmol* m^{-2} y^{-1}*. Under the very high* NO_3^- *concentrations of the Mincio River, the competition between primary production and denitrification processes was also avoided. A significant ammonium regeneration from sediments to the water column occurred in the* V. spiralis *meadow, where plant debris and particulate matter accumulated. Here, SRP was also released into the water column, whilst in the bare sediment SRP fluxes were close to zero. Overall,* V. spiralis *affected the benthic metabolism enhancing the ecosystem capacity to control nitrogen contamination. However, the actual N removal rates were not sufficient to mitigate the pollution discharge.*

Key words: Vallisneria spiralis*, oxygen and carbon dioxide fluxes, phosphorus and nitrogen cycling, denitrification*