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The effects of aquatic macrophytes on river water quality

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In the aquatic ecosystem, nutrient concentrations are continuously affected by a wide range of physical, chemical and biological processes resulting in a dynamic water quality status. In case macrophytes are growing in the river, the vegetation induces substantial changes to the water quality. Some effects are owing to direct interactions, such as the uptake of nutrients, whereas others may be merely attributed to indirect effect of the water plants on hydrodynamics and/or sediment chemistry. In order to improve water quality by integrated management practices, a more profound understanding and further quantification of the interactions between the macrophytes and the aquatic system is indispensable.

This research focused on the effect of macrophytes on dissolved nutrients. The study area is the lowland river Aa, a tributary of the Kleine Nete, located in the northern part of Belgium. Aquatic macrophytes are growing all over this river, reaching biomass densities up to 0.5 kg dry weight per m^2.

Along the river a 1.5 km stretch, bordered by two weirs, was selected for detailed monitoring in spring, summer and winter time. Upstream and downstream that stretch basic water quality characteristics were continuously measured and water samples were taken at regular time intervals and analysed for dissolved nutrient concentrations.

The water transport characteristics of the system were assessed based on repeated incoming and outgoing discharge measurements and based on modelling the passage of conductivity peaks through the (vegetated) river stretch. Subsequently the transport characteristics were applied to track the changes in water quality and to assess mass balances for the dissolved nutrients. In order to estimate the nutrient storage in aquatic vegetation, the macrophyte biomass density was measured at multiple locations and macrophytes were sampled for determination of the nutrient content.

Since the abundance of biomass is changing over the seasons, the macrophyte vegetation will be either a source or a sink of nutrients for the aquatic system. To study the sink effect, macrophytes were exposed to ^{15}N-labeled ammonium and nitrate solutions in a flume experiment. The accumulation of ^{15}N in the plant tissues was measured and nitrogen uptake rates were calculated. Considering the source effect on the other hand, a batch experiment was performed to follow up the release of nutrients to the water column during the decomposition process.

The results from the field measurements and the uptake/decay experiments will be discussed to assess the contribution of growing macrophytes to observed changes in water quality over the river stretch. The results are showing that the aquatic vegetation is affecting both the hydrodynamics and the dissolved the nutrient cycling. Furthermore, preliminary research is clearly indicating that for river water quality suspended solid dynamics, sediment processes and the effect of macrophytes on these processes are important as well.