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Understanding the effects of hydro-morphological restoration measures on nitrogen cycling in riverine landscapes

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River restoration measures aim to improve and sustain ecosystem services of degraded river systems. Typically, these measures increase the hydrological connectivity between the river channel and the floodplain water bodies, enhancing nitrogen retention and processing but potentially creating hotspots for in situ nitrous oxide production.

At present, the effects of river – floodplain restoration measures on nutrient cycling and nitrous oxide emissions in riverine landscapes remain a source of uncertainty. To improve our understanding of these effects, a study is being conducted in River Traisen, where the LIFE+ Traisen ecological restoration project took place (completed in 2016). In the frame of this project, large-scale flooding zones were restored, converting the formerly regulated river into a diverse floodplain landscape.

To understand how changes in hydro-morphological settings affect nitrogen cycling and nitrous oxide emissions, and what are the environmental drivers leading to changes in intermediate and end products in the restored riverine landscape, the nutrient status of water, sediment and soil samples was evaluated. At the restored area, transects were defined to cover a flooding-frequency gradient, including dry, periodically and permanently flooded plots. Further, the spatially-replicated transects aimed at investigating sites differing in both nitrogen sources (Traisen vs. Danube, rivers with contrasting nitrogen contents) and carbon sources (forest vs. grassland). Soil, sediment, gas and water samples were collected on a monthly basis, from May to November 2017. The chamber method was used for measuring nitrous oxide fluxes. Soil and sediment samples were analysed for exchangeable ammonia and nitrate, dissolved organic nitrogen, dissolved organic carbon (DOC), soluble reactive phosphorous, organic matter content and dissolved organic matter (DOM) quality. Water samples were analysed for total nitrogen, total phosphorous, DOC and DOM quality. Preliminary results on nutrient status point to differences along the flooding gradient, with the periodically flooded plots showing a marked sensitivity to the flooding events, and between sites due to different carbon sources.

Knowing the nutrient dynamics and nitrous oxide emissions from restored river – floodplain areas allows for a better understanding of the role of restoration in nutrient management and nitrous oxide production, and to better predict the impact of human activity in freshwater ecosystems.