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The effect of hydrological regime on base cations in the root zone of an alluvial wetland

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Many studies have demonstrated the importance of the base-richness gradient to explain floristic patterns in wetlands, especially fens or fen meadows. The origin of this gradient in these cases has been attributed to delivery of calcium either by groundwater, surface water or subsurface flow of canal water. However, little attention is paid to the role of soil processes and biological activity in generating or sustaining high concentrations of calcium and other base cations in soil solution. The aim of this study is to assess the contribution of different sources such as groundwater or surface water as well as internal soil processes to the high concentrations of calcium found in the soil solution of two alluvial wetlands with different hydrological regime on either side of a river, one groundwater-fed and one drained by a ditch. Soil solution was sampled during two years along a topographical gradient in the two wetlands. Measurements revealed a contrasting dynamical behaviour in calcium concentrations in the levee and in the depression of the groundwater-fed wetland and much higher concentrations in the depression. The dynamics in the depression were clearly linked to water level fluctuations. Detailed analysis of measured soil moisture content and speciation calculations for calcite revealed that solution of biogenic (root-derived) CO2, trapped in the waterlogged soil, was the dominant process rather than inflow of calcium-rich groundwater. The long-term consequence of this process is an exhaustion of soil calcite, eventually leading to a deterioration of current site conditions. This was confirmed by the significantly lower soil calcium content in the natural wetland compared to the drained system. In the short-term this effect creates a relative independence of the site conditions from concentrations in inflowing groundwater to sustain high calcium concentrations, opening up perspectives for protection of the natural site from desiccation. The results

also illustrate the complexity of interactions between hydrology, soil chemistry and plant occurrence.