

## **Drivers of plant species composition in siliceous spring ecosystems: groundwater chemistry, catchment traits or spatial factors?**

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### **ABSTRACT**

*Spring water reflects the hydrochemistry of the aquifer in the associated catchments. On dense siliceous bedrock, the near-surface groundwater flow is expected to be closely related to the biogeochemical processes of forest ecosystems, where the impact of land use is also low. We hypothesize that the plant species composition of springs mainly reflects hydrochemical conditions. Therefore, springs may serve as indicator systems for biogeochemical processes in complex forest ecosystems. To test this hypothesis, we investigate the influence of spring water chemical properties, catchment traits, and spatial position on plant species composition for 73 springs in forested catchments in central Germany, using non-metric multidimensional scaling (NMDS), Mantel tests, and path analyses. Partial Mantel tests and path analyses reveal that vegetation is more greatly influenced by spring water chemistry than by catchment traits. Consequently, the catchment's influence on vegetation is effective in an indirect way, via spring water. When considering spatial aspects (in particular altitude) in addition, the explanatory power of catchment traits for spring water properties is reduced almost to zero. As vegetation shows the highest correlation with the acidity gradient, we assume that altitude acts as a sum parameter that incorporates various acidifying processes in the catchment. These processes are particularly related to altitude – through bedrock, climatic parameters and forest vegetation. The species composition of undisturbed springs is very sensitive in reflecting such conditions and may serve as an integrative tool for detecting complex ecological processes.*

*Key words: acidification, catchment biogeochemistry, landscape traits, partial Mantel test, path analysis, spring water*

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