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Spring Communities – Terrestrial Island Habitats and Linkages to Ecosystem Traits at the Landscape Level

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Springs as Island Habitats

Due to their specific ecology, spring habitats and their communities are sharply distinguished from forest floor vegetation. This is mainly the case if helocrenic springs occur, which is the case in most Central European mountain ranges. There, springwater pours out slowly due to small catchments and near-surface transport in interflow strata.

These spring ecosystems are more or less constantly moist and perform constant thermic and hydric conditions. During winter, freezing and thawing mechanisms conduct small scale transport of substrate correlated with a leveling of the surface. This enhances the homogeneity of small scale site conditions within the spring itself. The homogeneity of the herbaceous and moss vegetation reflects these processes.

Figure 1: *Spring habitats and their plant communities are sharply differentiated from adjacent forest floor vegetation.*

Springs as Indicator Systems of Matrix / Landscape Condition

Spring vegetation proves to be a good indicator system to characterize the biogeochemistry of forested catchments. The short dwell period of these waters transported close to the surface features a close connection with the traits of forest ecosystems. Due to atmospheric deposition history during the last decades, these ecosystems are strongly modified. As shown in Fig. 3, low pH-values accompanied by high concentrations of toxic compounds in spring waters are an important factor that is explaining species composition in spring communities. Such values are enhanced in acidified forest catchments.

In Central European forest areas spatial patterns of load situations emerge on different spatial scales within and between landscapes (see Fig. 4). Patterns of plant species reflect hydrochemical properties. *Chrysosplenium oppositifolium* and *Cardamine amara* serve as indicator species for neutral conditions, *Sphagnum fallax* and *Polytrichum commune* for acidic conditions.

Springs as Natural Laboratories due to their Constancy

Springs are generally considered to represent natural laboratories for ecosystem research due to their relative constancy of temperature and water supply. If other ecological factors are modified, this will show direct response in the organismic community. On metamorphic siliceous bedrock groundwater flow occurs near to the surface and there are short turnover rates.

Vegetation of spring habitats in forested catchments is standing in close contact to groundwater and is strongly influenced by its hydrochemical conditions. Using multivariate statistical methods, higher plants, mosses and liverworts have been tested to identify (1) the driving forces of species composition and (2) indicator species, which react sensibly to changes in water chemistry.

Figure 2: *Groundwater with constant discharge and temperature melts the winter snow cover in the seepage zone of the spring.*

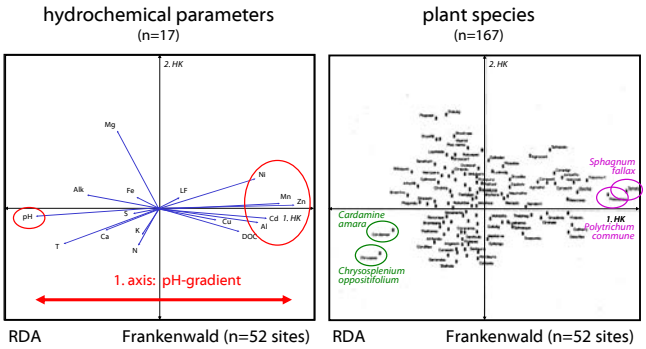

Figure 3: *Multivariate ordination (RDA) of hydrochemical parameters of springwaters (left) and corresponding plant species (right) .*

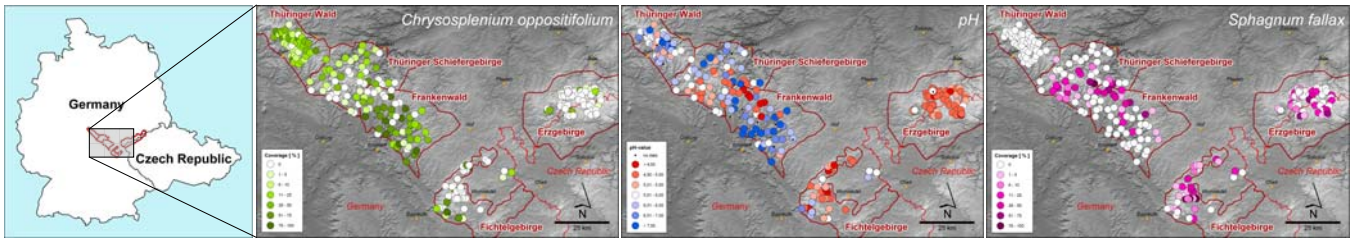

Figure 4: *Spatial patterns of load situations can be detected with water analyses as well as with vegetation records. The springwater pH-value (centre) shows the same pattern as reflected by the indicator species Chrysosplenium oppositifolium (left) and Sphagnum fallax (right).*

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