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Assessing the quality and quantity of N deposition by total N content and the stable isotope signatures in lichen tissue

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Anthropogenic activities have lead to major increases in global emissions of nitrogen (N). This change has led to large increases in deposition of atmospheric N to the terrestrial biosphere. Such increases in N deposition pose a outstanding ecological threat to plant community composition in many natural and semi-natural ecosystems. N deposition is known to be an important driver of biodiversity loss. For this reason N deposition should be monitored extensively. Because "conventional"- deposition measurement methods are afflicted with methodical and analytical sources of error, the present study researched the effects of atmospheric N deposition on epiphytic lichens. Lichens are natural monitors of our changing environment: the sensitivity of particular lichen species and communities to a very broad spectrum of environmental conditions, both natural and unnatural, is widely appreciated. Lichens are therefore used increasingly in evaluating threatened habitats, in environmental impact assessments, and in monitoring environmental perturbations, particularly those resulting from a disturbingly large and growing number of chemical pollutants.

In contrast to physical-chemical methods, lichens integratively indicate long-term effects of deposition on biological patterns and processes. In the present study, we tested whether the N concentrations and δ^{15}N ratios of lichens can be used to estimate deposition rates and to locate various sources of N compounds.

In winter 2008/09 and 2009/10 epiphytic lichens (*Physcia sp*. and *Xanthoria parietina*) were sampled from different sites located in the northwestern parts of Germany. Samples were collected within a radius of 2 km around field stations for deposition measurement, from trees that met the requirements for bioindication with lichens (VDI DIRECTIVE 3799/1). Besides, we sampled lichens in 174 grid units (each unit 25 km x 25 km) for geostatistical analyses.

We were able to show that the N content of epiphytic lichens reflects the N deposition circumstances at various sites in the northwest of Germany. We found ranges between high N concentrations in *X. parietina* and *Physcia sp.* under high N deposition. Lower N concentrations we found in unpolluted areas. δ^{15}N signatures of both researched epiphytic lichen species are more negative under high ammonium deposition. The verification of highly negative δ^{15}N ratios at sites with local (agriculture) and regional emitters (Benelux through Western winds) shows that source attribution by comparing different δ^{15}N signatures is possible. With geostatistical methods, we were able to underline the improvement of a monitoring method which can be used extensively to support current field stations of deposition measurement by exact and far-reaching assessing of quantity and quality of present N deposition in the environment.