

Title	Element accumulation in boreal bryophytes, lichens and vascular plants exposed to heavy metal and sulfur deposition in Finland
Author	Maija Salemaa , John Derome and Ilkka Vanha-Majamaa etal
Journal	Science of The Total Environment
Abstract	Macronutrient (N, P, K, Mg, S, Ca), heavy metal (Fe, Zn, Mn, Cu, Ni, Cd, Pb) and Al concentrations in understorey bryophytes, lichens and vascular plant species growing in Scots pine forests at four distances from the Harjavalta Cu–Ni smelter (0.5, 2, 4 and 8 km) were compared to those at two background sites in Finland. The aim was to study the relationship between element accumulation and the distribution of the species along a pollution gradient. Elevated sulfur, nitrogen and heavy metal concentrations were found in all species groups near the pollution source. Macronutrient concentrations tended to decrease in the order: vascular plants>bryophytes>lichens, when all the species groups grew on the same plot. Heavy metal concentrations (except Mn) were the highest in bryophytes, followed by lichens, and were the lowest in vascular plants. In general, vascular plants, being capable of restricting the uptake of toxic elements, grew closer to the smelter than lichens, while bryophytes began to increase in the understorey vegetation at further distances from the smelter. A pioneer moss (<i>Pohlia nutans</i>) was an exception, because it accumulated considerably higher amounts of Cu and Ni than the other species and still survived close to the smelter. The abundance of most of the species decreased with increasing Cu and Ni concentrations in their tissues. <i>Cetraria islandica</i> , instead, showed a positive relationship between the abundance and Cu, Ni and S concentrations of the thallus. It is probable that, in addition to heavy metals, sporadically high SO ₂ emissions have also affected the distribution of the plant species.
Year	2004
Pages	141- 160
keywords	