

<b>Title</b>	<b>Spatial dispersal of airborne pollutants and their effects on growth and viability of lichen transplants along a rural highway in Norway</b>
<b>Author</b>	Olena A. Yemets, Knut Asbjørn Solhaug and Yngvar Gauslaa
<b>Journal</b>	The Lichenologist, Vol. 46, Issue 06
<b>Abstract</b>	<p>This study aims to quantify dispersal of airborne traffic-related elemental pollutants and concurring responses – relative growth rate (RGR), maximal quantum yield of PSII (<math>F_v/F_m</math>), and chlorophylls (Chl <i>ab</i>) – in four epiphytic lichens (<i>Lobaria pulmonaria</i>, <i>Parmelia sulcata</i>, <i>Ramalina farinacea</i>, <i>Usnea dasopoga</i>). Lichens were transplanted from 25 September to 26 March to 1.5 m tall stands in open farmlands at 10, 15, 30, 50 and 100 m from the E6 highway (SE Norway), along three transects on each side usnea dasopoga of the road. The concentrations of most elements (Ca, Mg, Na, Fe, Al, Zn, Ba, Cu, V, Cr, Ni, Co, Sn, As, Mo) significantly increased with increasing proximity to the road. Elements in bold had elevated concentrations relative to controls, at least in some species at 100 m. The heavy metal accumulation increased from foliose to fruticose lichens in the order: <i>P. sulcata</i>&gt;<i>L. pulmonaria</i>&gt;<i>R. farinacea</i>&gt;&gt;<i>U. dasopoga</i>. However, <i>L. pulmonaria</i> was the only species with strong pollutant-dependent reductions in growth, <math>F_v/F_m</math>, Chl <i>ab</i>, and Chl <i>a/b</i>-ratio. The RGR and viability parameters were adversely affected by the roadside environment near the road only (<math>\leq 15</math> m), and only after substantial heavy metal accumulation. Measurement of metal accumulation in lichens is thus a far more sensitive way of monitoring road pollutants than recording growth and lichen viability. Despite strong species-specific contrasts in elemental concentrations, most road pollutant elements responded similarly to distance from the road in all species.</p>
<b>Year</b>	2014
<b>Pages</b>	809-823
<b>keywords</b>	Biomonitoring, epiphytic lichens, heavy metals, relative growth rate, salt

<b>Title</b>	<b>Lichens as sentinels for air pollution at remote alpine areas (Italy)</b>
<b>Author</b>	Stefano Loppi
<b>Journal</b>	Environ Sci Pollut Res, Vol. 21

<b>Abstract</b>	The present study was undertaken with the aim of using epiphytic lichens as sentinels for air pollution at two remote alpine sites (1,400 and 1,800 m above sea level (asl)) of NW Italy. The results indicated that the site at 1,800 m prompted for early warning indications of biological changes. Although levels of the many elements assayed in samples of the lichen <i>Pseudevernia furfuracea</i> (L.) Zopf, ranging from minor elements (e.g., Al) to ultra-trace (e.g., Pt), were at normal levels, indications of a slowly worsening environment were given by the lichen biodiversity and by damage to cell membranes. The analysis of Pb isotopic ratios suggested that the origin of Pb accumulated in lichens is not local, but linked to the long-range transport by air masses. It was concluded that the origin of pollutants is from air mass coming from the Po plain of Italy and from densely populated areas of Switzerland and France.
<b>Year</b>	2014
<b>Pages</b>	2563–2571
<b>keywords</b>	Biodiversity, Cell membrane damage, Heavy metals, PGEs, REEs, Transboundary pollution

<b>Title</b>	<b>Correlation among carbon, nitrogen, sulphur and physiological parameters of <i>Rinodina sophodes</i> found at Kanpur city, India</b>
<b>Author</b>	Satya, D.K. Upreti
<b>Journal</b>	Journal of Hazardous Materials, Volume 169(1-3)
<b>Abstract</b>	Accumulation of carbon, nitrogen and sulphur content in <i>Rinodina sophodes</i> , crustose poleotolerant lichen growing naturally in and around six sites of Kanpur city was estimated, and their influence on the photosynthetic pigments of the lichen was studied. Maximum carbon concentration was recorded at highly polluted area while higher accumulation of nitrogen was recorded near village in outskirts of the city having higher ammonia emission. The concentration of sulphur was not detected in most of the sites except a single site where it had a quite lower value (0.22%). Photosynthetic pigments (chlorophyll a and b) increased parallel to the level of traffic density. Multiple correlation analysis revealed that chlorophyll a had highly significant correlation (1%) with chlorophyll b ( $r = 0.9986$ ) and total chlorophyll ( $r = 0.9307$ ). Carbon is directly correlated with nitrogen ( $r = 0.3035$ ), sulphur ( $r = 0.1743$ ) and chlorophyll degradation ( $r = 0.2685$ ) while negatively correlated with chlorophyll a ( $-0.3323$ ), chlorophyll b ( $r = -0.3429$ ) and total chlorophyll ( $r = -0.0824$ ). Nitrogen showed negative correlation between all photosynthetic pigments and chlorophyll degradation, while in case of sulphur, it was high positive correlation at 1% with chlorophyll degradation (0.9445).
<b>Year</b>	2009
<b>Pages</b>	1088- 1092
<b>keywords</b>	carbon, nitrogen, sulphur, <i>Rinodina sophodes</i> , crustose poleotolerant lichen

