

<b>Title</b>	<b>Integrated biomonitoring of air quality with plants and lichens: A case study on ambient ozone from central Italy</b>
<b>Author</b>	C. Nalia, E. Balducci, E. Balducci, S. Loppi and G. Lorenzini
<b>Journal</b>	Chemosphere
<b>Abstract</b>	A biennial integrated survey, based on the use of vascular plants for the bioindication of the effects of tropospheric ozone together with the use of automatic analysers of ozone, as well as the mapping of lichen biodiversity was performed in the area of Castelfiorentino (Tuscany, central Italy). Photochemically produced ozone proved to be a fundamental presence during the warm season, with maximum hourly means reaching 114 ppb, exceeding the information threshold as fixed by EU: the use of supersensitive tobacco Bel-W3 confirmed the opportunity of carrying out detailed cost-effective monitoring surveys. The potential for didactical and educational implications of this methodology are appealing. Critical levels set up for the protection of vegetation have exceeded considerably. The comparison of biomass productivity in sensitive and resistant individuals (NC-S and NC-R white clover clones, in the framework of an European network) provided evidence that ambient ozone levels are associated with relevant reduction (up to 30%) in the performance of sensitive material; effects on flowering were also pronounced. The economic assessment of such an impact deserves attention. Mapping of epiphytic lichen biodiversity – which has been used to monitor air quality worldwide – was not related to ozone geographical distribution as depicted by tobacco response.
<b>Year</b>	2007
<b>Pages</b>	2169- 2176
<b>keywords</b>	

<b>Title</b>	<b>Lichens and tobacco plants as complementary biomonitors of air pollution in the Grenoble area (Isère, southeast France)</b>
<b>Author</b>	S. Gombert, J. Astaand M.R.D. Seaward
<b>Journal</b>	Ecological Indicators
<b>Abstract</b>	This biomonitoring study was aimed at providing an overall assessment of nitrogen oxides (NOX) and tropospheric ozone (O3) in the Grenoble area (Isère, France). Two bioindicators, lichens and tobacco plants, were used to estimate, respectively, the spatial distribution of NOX and O3. The following methodological approaches were adopted: bioaccumulation of nitrogen in the lichen <i>Physcia adscendens</i> , bioindication of ozone as shown by visible injury to tobacco plants (cv. Bel W3), and biomonitoring at the lichen community level (IAP). Complementary biomonitoring maps, the first based on nitrogen concentrations of lichens and the second based on tobacco leaf injuries, were highly comparable with results obtained from physico-chemical analyses. Multivariate analyses (Canonical Correspondance Analysis) were used to determine the relationships between levels of atmospheric NO2 and O3 and the lichen communities (IAP). A lichen sensitivity scale to NO2 and O3 was attempted for 43 epiphytic species, from which it was possible to define five clusters according to their indifference, sensitivity or resistance to NO2 and O3.
<b>Year</b>	2006

<b>Pages</b>	429- 443
<b>keywords</b>	

<b>Title</b>	<b>Lichen (<i>Xanthoria parietina</i> biomonitoring of trace element contamination and air quality assessment in Livorno Province (Tuscany, Italy)</b>
<b>Author</b>	R. Scerbo, L. Possenti, L. Lampugnani and C. Barghigiani
<b>Journal</b>	Science of The Total Environment
<b>Abstract</b>	<p>This paper deals with the biomonitoring of air in Livorno Province (Tuscany, Italy) using lichens for both quantitative monitoring of airborne metals and air quality assessment. On the basis of the possible sources of metal pollution in the study area, the following elements were analyzed: As, Cd, Cr, Ni, Pb, V, Zn and Hg. The small number of lichen species, the often stunted appearance of the specimens, and metal analysis revealed widespread atmospheric pollution in the study area. The results indicate extensive anthropic impact. The highest levels of contamination were recorded for Hg, Cd, Pb, and V concentrations. Good agreement was found between bioindication and metal concentrations in lichens. The impact of anthropic activities is particularly due to steelworks and chemical plants, combustion processes related to energy production and vehicle emissions. In addition to air pollution, some natural factors, such as climate, rocky shores or ozone, were assumed to affect lichen occurrence. Comparison with the Lake Orta area in northern Italy showed Livorno Province was more contaminated by trace elements. Similar contamination levels were found in another area of Tuscany, probably due to the geological characteristics of this region.</p>
<b>Year</b>	1999
<b>Pages</b>	91- 106
<b>keywords</b>	