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Pollutant-related mapping of lichens on the Integrated-Monitoring-site Zöbelboden in the Reichraminger Hintergebirge, Oberösterreich, Austria

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Abstract

An intensive research station of the Federal Environmental Agency for Air Quality Control is situated at Zöbelboden in the Reichraminger Hintergebirge. After a basic study in 1993, a repeated investigation of epiphytic lichens was carried out in 1999. Samples of lichen vegetation on a total of 81 trees were taken by various methods and evaluated in regards to pollution levels. This study will be repeated again in summer of 2005.

A comparison of the species found during the pollution related mapping study with the potential lichen vegetation shows a severe reduction in epiphytic lichen vegetation on the sample trees in the biomonitoring project area. Macrolichens frequently show clear limitations in vitality. While the coverage of nitrophilic and toxitolerant species increased, the coverage of more sensitive species was reduced.

A multifaceted analysis was also carried out on the results of 1999. On the whole, there has been a measurable decrease in air quality in the period between 1993 and 1999.

Integrated monitoring and research area

Since 1992 the Federal Environment Agency Austria for Air Quality Control runs a research station for measuring the air quality at the Zöbelboden in the National Park Kalkalpen. This station is part of the Trans-European network Integrated Monitoring, which investigates the long term effects of long range air pollutants originating from wide areas of Europe and other parts of the northern hemisphere. The minimum study areas have a size of 1 km^2, in which the pollutant input and its long term effect on the concerned ecosystems are monitored. The air pollutants are measured continuously, while the specific research on the effects on the diverse parts of the ecosystems is carried out periodically. The Zöbelboden was chosen as research area as an ECE Integrated Monitoring site because it is situated in the north exposed Calcareous Alps, where the polluted air streams coming from North-West are dammed up (HOFMANN 1996, TÜRK et al. 2001).

Material and Methods

The first pollutant related mapping study on the Zöbelboden was carried out 1993 by Hofmann. This study was repeated in 1999 by TÜRK et al. (2001). A further study will be carried out in summer 2005.

In 1993 Hofmann did relevés on 70 marked trees and he registered the cover and the frequency of crustose, foliose and fruticose lichens according to the method of HOFMANN (1992, 1993). He assessed coverage, size of the thalli and the area of the damaged part of the lichens growing on the best covered part of the stem in a defined altitude of the stem.

The repeated mapping study in 1999 was expanded by using the methods of TÜRK & ZIEGELBERGER (1982) and the VDI-Guideline 3799 (1995). To find the areas of relevés on the bark in further studies, the top left hand corner was marked by coloured pins. A multifaceted analysis was carried out on the basic data of the results.

Results and Discussion

At the mapping studies in 1999 in total 99 epiphytic and epixylic lichen taxa were found. This high number of species is caused by favourable conditions of humidity. Also the high amount of dead woody litter increases the diversity of lichens. According to the list of threatened lichens of TÜRK and HAFELLNER (1999) there are many endangered and heavily endangered species. The species inventory corresponds to the climatic conditions in the kolline and montane step of the Northern

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Calcareous Alps. On many specimens of macrolichens a reduced vitality is recognizable on an unusual change of colour and on reduced growth.

The distribution of the lichen species in the mapping area and its surroundings shows significant differences between windward and leeward situation of the ridges. In sheltered areas with only a slight effect of the air pollutants is the potential lichen flora developed, whereas in the exposed sites of the monitoring area the diversity of lichens is reduced. Comparing the results between 1993 and 1999 a deterioration of the vitality of lichens and a reduction of the coverage of sensitive species could be observed, whereas toxitolerant species increased the coverage and abundance. The presence of nitrophilous lichens like *Melanelia glabratula* and *Hypotrachyna revoluta* indicates a permanent eutrophication of the bark by air pollutants. Also the coverage and the vitality of the more or less acidophiytic *Hypogymnia physodes* decreased between 1993 and 1999. According to the sheltering effects caused by the orographic position of the areas zones with different pollution levels were found. The areas of the plateau on the top of the Zöbelboden was slightly polluted, the basic slopes were strongly polluted. Unpolluted areas could not be found. The same air load as 1993 was detectable at 40 % of the sites in 1999, at 54 % of the sites a deterioration.

The investigations at the Zöbelboden are an example for advanced science in a National Park. The previous and present results have a national and international significance because they clearly demonstrate the development of the air quality in Central Europe and in the edges of the northern parts of the Eastern-Alps. The registration of the lichen flora in the complete area of the National Park Kalkalpen would be a great support for the interpretation of the results of the pollutant-related investigations on the lichen vegetation in the Zöbelboden.

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