

## **Dendrochemical analysis of tree rings and bark in environmental impact assessment and monitoring studies in Germany**

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Results of dendrochemical analysis of annual tree rings and tree bark in the context of case studies in Germany on Environmental Impact Assessment (EIA) and monitoring are summarised. One study was undertaken first in 1993-1995 (Hofmann et al. 1998) and secondly repeated in 2002-2004.

In the surrounding area of point emission sources in Northern Germany 150 sites were chosen according to an impact analysis based on dispersion modelling and aerial CIR-analysis of forest damage in the area. Using 5mm-increment borer 500 cores were taken from damaged and healthy looking trees for analysis of growth changes between these two subpopulations. At 112 sites the outer tree bark was removed with an inventory device (Hofmann et al. 2001), that permits the removal of the outer tree bark in predefined thickness. Selected trees of oak were cored by a special coated 12-mm borer using additionally inside PP-tubes for protection against contamination. The cores were deep-frozen and later freeze-dried in the lab.

The samples of the outer tree bark and the tree rings were analysed for:

- 54 elements using ICP-MS, RMA (EDAX) and elemental analysers for metals, nutrients and lanthanides including S, N, P, Ca, Al, Mn, Ba;
- the isotopic ratios of S and N by element-MS.

The main results of our studies:

- The outer tree bark is an excellent biomonitor of air pollution loads. Tree bark sampling is fast done and compared to technical measurement devices of aerosol sampling very cheap, so that many sites can be investigated for evaluating the spatial variation of pollution. Further on, the broad range of substances detected allowed to identify characteristic patterns of various emission sources, so that the specific air pollution impact could be estimated by fingerprinting analysis.
- The dendrochemical data of the tree rings could be interpreted - when combined with other data on tree growth, soil condition/pollution and air pollution - to indicate the biological effects of the changing environment over time. They were especially useful to estimate the time scale and dynamics of the ecosystem changes, that could not be gained by other methods.

Hofmann, F., Schlechtriemen, U., Wosniok, W., Reckel, S. (1998): Integrated Monitoring for Identifying the Specific Air Pollution Impacts of Industrial Emission Sources. In: Stravinskiene, V., Juknys, R. (Ed.) Dendrochronology and Environmental Trends. Proceedings of the International Conference EuroDendro 1998, Vytautas Magnus Univ., Kaunas, Lithuania, p. 160-168

Hofmann, F., Wosniok, W., Siemers, U., Giesemann, A., Duve, M., Bracke, G. (2001): Luftgüte-Rindenmonitoring mit Immissions-Fingerprinting - Ein neues Probenahmegerät und Verfahren zum Biomonitoring von Luftschadstoffen für akkumulierbare Substanzen mit der Möglichkeit des Fingerprintings von Immissionsquellen. Ecomed, Landsberg, 156 S; Gate to EHS, DOI:<http://dx.doi.org/10.1065/ehs2001.05.009>