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BIOMETRIC SAMPLE CHARACTERIZATION PART I: THE INFLUENCE OF THE INFESTATION WITH INSECTS TO ELEMENT CONCENTRATIONS IN SPRUCE NEEDLES

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Abstract

The standardization of sampling procedures is one of the most important prerequisites for getting reproducible results in biomonitoring. Nevertheless, it is not possible to sample specimens of a single species which are fully comparable because of the high temporal dynamic of ecosystems causing inherent variability of each specimen type. Biometric sample characterization may describe in detail this unique state of samples. It is a very important tool for the correct assessment of environmental pollution. The sampling operating procedures of the German Environmental Specimen Banking Programme include a list of suitable biometric parameters for each specimen type that fulfill this function. This will be shown by two examples. Part I of this publication demonstrates the influence of infestation with insects to needles of spruce [*Picea abies*] on concentrations of elements and Part II the relation between the size of needles and concentrations of airborne pollutants. © 1997 Elsevier Science Ltd

1 Introduction

The standardization of sampling procedures is one of the most important prerequisites for getting reproducible results in biomonitoring because it reduces variability of natural and man made phenomena [s. Tab. 1]. These phenomena are found in different biological levels from the individual to population and ecosystems [1]. In the context of quality assurance approaches of standardization for many terrestrial and limnetic specimen types are described by Klein & Paulus [2].

Nevertheless, it is not possible to sample specimens that are fully comparable because of the high dynamic of ecosystems over space and time causing **inherent variability** of each specimen type [3]. Therefore, it is necessary to describe this unique and not standardizable state of specimens by biometric parameters. Biometric sample characterization may be used for a correct interpretation of the data given by chemical analysis of specimens. This will be shown illustrating the influence of insect damage to needles of spruce [*Picea abies*] on concentrations of elements.

Tab. 1: Levels of variability and sampling requirements for the reduction of variability.

Levels of variability	Sampling requirements
Time	Definition of sampling period and frequency
Space	Definition of sampling site in matters of topographical position and surface; influencing also the methodical design
Sex	Selection of one sex or an adequate sex ratio
Age	Selection of an age group
Genetic	Selection of a geneticly stable group
Individual	Selection of a compartment of an individual

The spruce [*Picea abies*] is a suitable accumulation indicator for heavy metals and airborne polyhalogenated aromatic hydrocarbons [PHAHs]. Infestation with insects is often observed in different intensities and can not be excluded or standardized by sampling but damages the needles. These damages may alter the content of chemicals in samples of spruce shoots by

- increasing leaching effects by lesions of the cuticula and cell membrane
- increasing the uptake of airborne xenobiotics due to damaged needle surface
- altering the weight basis for calculating concentrations of elements by loss of cell and tissue sap.

2 Methods

To study the influence of infestation with *Adelges laricis* [Aphidoidea, Hemiptera] infested and opposite non infested one-year-old spruce shoots were selected. The samples were collected in the forest "Warndt" which is exposed to industrial emissions and sited in the south west of the state Saarland, Germany. 70 infested and 70 opposite non infested shoots were sampled in August, September, November, and January 1992 and 1993 respectively. Calcium, potassium, cadmium, and lead were analyzed by atom-adsorption-spectroscopy. Calcium and potassium were selected because of different mobility in plants. Calcium is less mobile than potassium and characterized by a low exchange rate between cells whereas potassium is very mobile and may be leached by rainwater. Cadmium and lead are very common in the environment. Cadmium is absorbed from the soil by roots whereas lead is incorporated by leaves from the athmospheric deposition. Additionally, cadmium is very mobile but lead is normally moved to a less extent [4].