Pergamon

Chemosphere, Vol. 34, Nos 9/10, pp. 2015–2021, 1997

PII: S0045-6535(97)00063-5
0045-6535/97 $17.00+0.00

BIOMETRIC SAMPLE CHARACTERIZATION
PART II: THE RELATION BETWEEN THE SIZE OF NEEDLES AND CONCENTRATIONS OF AIRBORNE POLLUTANTS

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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. part I]. 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 [1]. 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. In addition to part I it will be demonstrated by a further example: the relation between the size of needles and concentrations of airborne pollutants.

Concentrations of xenobiotics in relation to weight [µg/kg, mg/kg etc.] are usually used for the presentation of the burdening of a specimen by specific chemical compounds in order to compare chemical analysis in the same specimen type over space and time. The comparability is accepted if concentrations of chemicals are analyzed in the same specimen type [for instance, one-year-old spruce shoots from the upper part of trees sampled in a defined period] and the reference parameters [wet weight, dry weight, fat content etc.] are the same. It will be shown on the example of spruce needles that the concentration of chemicals related to weight is not always the best basis for a correct interpretation of chemical data in biota but needle size.

2 Methods

Results of chemical analysis in one-year-old spruce shoots from the sampling area "Bornhoeved lake area" of the german environmental specimen bank are presented [2, 3]. Standardized spruce specimens were sampled respectively from 15 trees in 1987, 1989, and 1991. The standardization refers to the age of trees and shoots, the exposition of shoots in relation to the wind direction and the insolation, the position of spruce shoots, the sampling period etc. [4]. A part of the collected shoots were dried at 80° C until weight constancy. 1000 needles per tree were counted and weighted. A further part of the shoots was chemically characterized, i.e. 10 elemenets and 14 polycyclic aromatic hydrocarbons were analyzed by the "Forschungszentrum Jülich" and the "Biochemischen Institut für Umweltcarcinogene", respectively.

3 Results and conclusions

The 1000-needle-weight [tnw] - an indicator of climatic conditions - shows the inherent variability of spruce samples from the "Bornhoeved lake area" over several years. Values in 1991 are significantly different from values in 1987 and 1989 [$p < 0.001$, fig. 1]. In order to test if the mentioned inherent variability affects the analyzed chemical compounds the 1000-needle-weight and the chemical concentrations in the shoots were correlated. Tab. 1 shows the negative log-linear correlation between 12 of 14 analyzed PAH's and the tnw. The statistical models used implie that 25 to 44 percent of the chemical variation is related to the tnw. When correlating the analyzed elements and the tnw, a negative log-linear correlation is found only for lead [tab. 2].

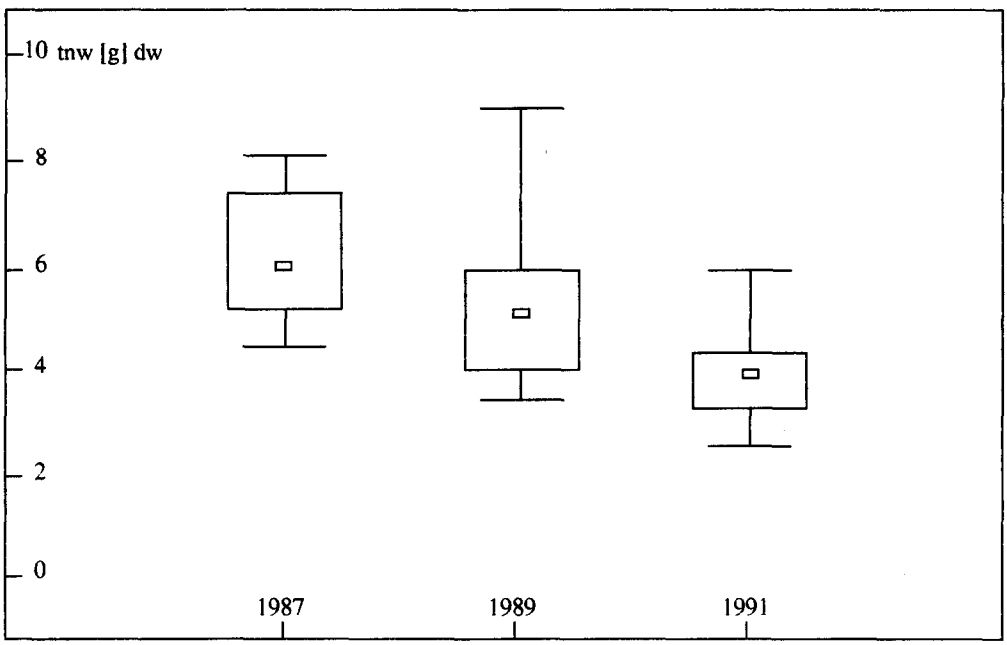

Fig. 1: 1000-needle-weight of sampled spruce needles from the "Bornhoeved lake area".

Under the assumption that the tnw is an indicator of the needle size, one reason for the correlations between most PAH's and lead on the one side and the tnw on the other side may be related to the uptake of both "group" of chemical compounds by the needles from the athmospheric deposition. In this context, it is important that big needles have a relatively small adsorption surface whereas small needles have a relatively big adsorption surface. In addition, when calculating the chemical content as concentration, i.e. related to weight [e.g. mg/kg], the absolute number of big needles per weight unit is lower than the number of small needles. This is a second "effect" which decreases the adsorption surface of big needles in comparison to small needles. Consequently, the concentrations of PAH's and lead decrease in years when the tnw increases and vice versa without any change of the athmospheric burdening.