PASSIVE AND ACTIVE BIOMONITORING OF ATMOSPHERIC AEROSOL WITH THE USE OF MOSSES

Nikola SŁONINA[1], Paweł ŚWISŁOWSKI[1,2*] and Małgorzata RAJFUR[1*]

[1]Institute of Environmental Engineering and Biotechnology, University of Opole, kard. B. Kominka 6a, 45-032 Opole, Poland,
[2]Institute of Biology, University of Opole, ul. Oleska 22, 45-052 Opole, Poland
*e-mail: pawel.swislowski@uni.opole.pl, rajfur@uni.opole.pl

Abstract

The aim of the carried out research was passive and active biomonitoring of woodlands in the Opole province. *Pleurozium schreberi* mosses were used during the research, in which the following heavy metals concentrations were determined: Mn, Fe, Ni, Cu, Zn, Cd and Pb. Concentrations were determined with absorption atomic spectrometry (AAS). On the basis of the carried out research, concentrations of heavy metals in moss samples used in the passive and active biomonitoring methods were compared. The obtained results indicate that *Pleurozium schreberi* mosses can be successfully used in both passive and active biomonitoring, however, these methods should not be used interchangeably in a defined study area. On the basis of carried out research it was determined that the applied biomonitoring methods can be supplementary.

Keywords: passive biomonitoring, active biomonitoring, mosses, heavy metals, atomic absorption spectrometry

Materials and methods

Pleurozium schreberi mosses were used in the study carried out during the period July-September 2020. In passive biomonitoring mosses were collected in the woods of Turawa commune in Opole voivodeship (Fig. 1). Moss samples were collected from the locations with 1 m x 1 m areas Active biomonitoring was carried out by exposing mosses for 3 months in 11 measuring location where mosses were collected within passive biomonitoring (Fig. 1).. The samples were collected and dried at 295 K temperature, to obtain dry mass. Such prepared samples were stored in tightly closed polyethylene containers. The representative (averaged) mosses samples (green parts of gametophytes) with the mass of 1.000 ± 0.001 g d.m. (d.m. – dry mass) were mineralised in the mixture of nitric acid (V) and hydrogen peroxide (HNO_3 65% : H_2O_2 37% = 3:1) using a Speedwave Four Berghof (DE) microwave oven. The mineralization process temperature was 180 °C. MERCK company reagents were used to prepare solutions. Heavy metals (Ni, Cu and Zn) in mineralised samples were determined by the method of atomic absorption spectrometry with flame excitation (F-AAS), using the equipment iCE 3500 made by Thermo Electron Corporation (USA).

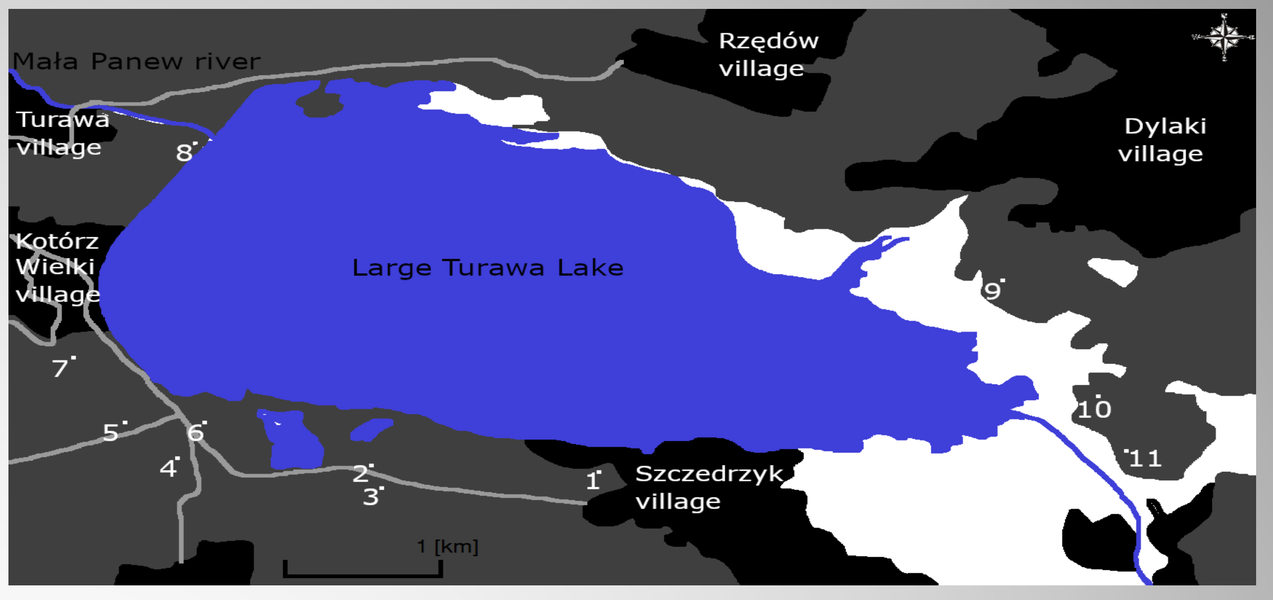

Fig. 1. Locations of biomonitoring studies (blue fields - reservoir, river; black fields - urban area; grey fields - woodlands; grey lines - roads)

Fig. 2. *Pleurozium schreberi* mosses

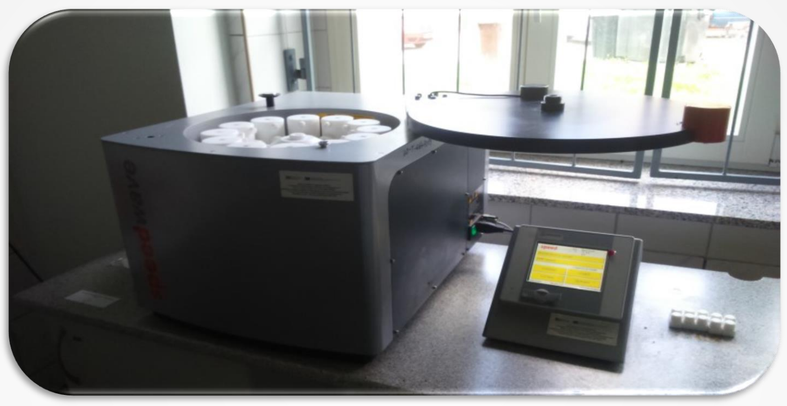

Fig. 3. Speedwave Four Berghoff (DE), microwave oven

Fig. 4. *F-AAS*, iCE 3500 Thermo Electron Corporation (USA)

Results

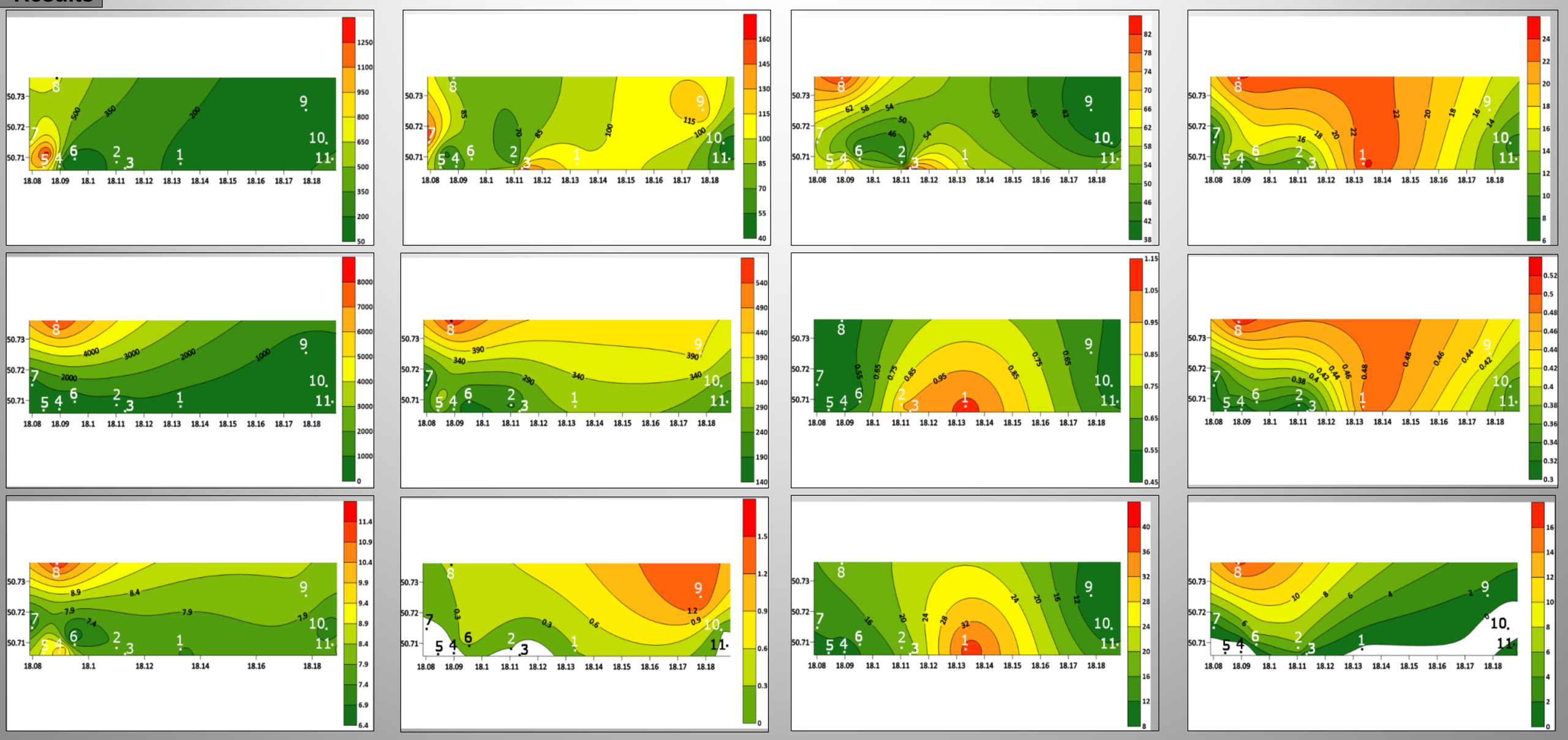

Fig. 5. Spatial distribution of Mn, Fe, Cu (top-down) in the research area determined on the basis of concentration of the analyte in moss samples [mg/kg d.m.] collected by passive method (left), exposed in active biomonitoring (right)

Fig. 6. Spatial distribution of Zn, Cd, Pb (top-down) in the research area determined on the basis of concentration of the analyte in moss samples [mg/kg d.m.] collected by passive method (left), exposed in active biomonitoring (right)

Conclusions

Mosses are perceived as one of the major bioindicators of heavy metal pollution in air biomonitoring. Analysis of, among others, heavy metals concentrations captured in mosses provides much information regarding the pollution introduced to atmospheric aerosol, allows to asses changes in air quality and to identify the sources of pollution.

Currently, two methods of atmospheric aerosol biomonitoring with the use of mosses are used: passive and active. The research results obtained thanks to the use of these methods have not been compared so far. This is the result of heterogeneity of the research material and many factors, which influence the final result.

On the basis of carried out research, the authors suggest that passive and active biomonitoring methods should not be used alternatively in the same study area, but they can be complementary. Simultaneously it was proved that active biomonitoring method produces more reliable results in comparison to passive biomonitoring.