

# ECOLOGICAL MONITORING — HEAVY METAL ACCUMULATION IN SOME REGIONS OF THE WORLD

by

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**Introduction.** Rapid development of industry in the last 30 years caused serious environmental pollution of almost the whole globe with heavy metal dusts. The dusts reach as far as the Arctic zone, considered to be the most natural and "pure" area, and are transported there through the air. Heavy metals penetrate into the ecosystems, circulate and accumulate in them, thus polluting a series of components of these ecological units.

Environmental pollution is frequently assessed by means of biological methods using plants from different systematic groups as indicators. Mosses appear to be sensitive and accurate indicators of heavy metal pollution. They possess a set of advantages as indicative plants:

- 1) lack of cell walls makes them draw mineral salts mainly from rainfall and dry falls through the leaves;
- 2) moss cell walls are covered neither by an epidermis nor by a cuticle; therefore, the penetration of metal ions into the cells is very easy;
- 3) moss species have a vast geographical distribution and they occur in abundance both in natural, urbanized and industrialized territories.

For the reasons stated above, we selected mosses as indicator plants in evaluating the actual contamination of the environment of some parts of the world including the Arctic and Antarctic zones.

**Materials and methods.** *Pleurozium schreberi* collected from dozens of localities on Spitsbergen, northern Finland, northern Korea and also from 14 national parks in Poland, and *Sanionia uncinata* from Spitsbergen and from the Arctic were used as test samples.

During each testing the level of cadmium, nickel, lead, copper, and zinc was determined with the aid of an atomic absorption spectrophotometer (AAS Varian Techtron 20 BQ).

**Results and discussion.** The content of all heavy metals examined was lowest in the mosses collected in the Arctic zone and Spitsbergen, whereas the highest levels were found in the samples from the Ojcowski National Park in southern Poland. The concentration of lead was 45 times higher in Ojców than it was on Spitsbergen; the concentration of zinc, cadmium, copper and nickel was respectively 16, 10, 4 times higher. The Antarctic mosses are less contaminated than the Arctic mosses. The concentration of cadmium on Spitsbergen is three times the concentration of this metal in the Antarctic, whereas the concentration of nickel is 2-, zinc 1.5- times the concentration in the Antarctic. Only the concentration of lead in both territories is similar.

The Polish Polar Station of the Polish Academy of Sciences is located on Spitsbergen (Horsund area). To have an idea about the influence of the Station on environmental pollution e. g. the influence of fuel storing, coal consumption etc., some moss species were collected from several transects 1 to several meters from the Station.

The concentration of cadmium, copper, nickel, lead and zinc was found to be two- to three-times higher in the mosses growing up to 15 meters from the storage tanks for oil and petrol and from an

electricity unit when compared with the moss localities 30 meters from the objects in question. The influence of the Polar Station on environmental pollution with heavy metals is, therefore, significantly local. To assess the level of metal accumulation in different moss species, seven species growing on Spitsbergen were studied: *Aulacomnium turgidum*, *Dicranum groenlandicum*, *Hylocomium splendens*, *Pleurozium schreberi*, *Polytrichum alpinum*, *Racomitrium lanuginosum*, *Sanionia uncinata*. Differences in the metal contents between the species were detected, but only a part of these differences was statistically important. The following specimens turned out to be the most powerful accumulators of heavy metals: *Hylocomium splendens*, *Pleurozium schreberi* and *Sanionia uncinata*, while *Racomitrium lanuginosum* and *Dicranum groenlandicum* turned out to be the weakest ones.

However, the heavy metals accumulated in the mosses do not always come directly from air pollution. Frequently, they might be of secondary origins. A study was carried out along three transects which ran through the colony of *Plautus alle* L. on the south-eastern slopes of Arieikamen. *Sanionia uncinata*, *Hylocomium splendens*, were used as test species. Within the range of the *Plautus alle* L. colony the accumulation of heavy metals in the mosses was several times higher than in the localities above or below the colony.

In the sea invertebrates, which constitute the birds food. high concentrations of heavy metals were found. Heavy metals excreted by the birds enter the Arctic tundra ecosystem and are absorbed by mosses and other life forms.

In separate links of the trophic chains the increase in the concentration of heavy metals can be observed. In the Arctic ecosystems the chains are short, and consist of only two to four units.

The level of accumulation of heavy metals in different body parts of *Plectrophenax nivalis* and in "average" plant samples constituting the food of those birds was assessed. The increase in concentration of these metals in parts of *Plectrophenax nivalis* was up to ten times higher than in the plants. Lead and cadmium were accumulated mainly in the long bones and in flight feathers, iron and copper in the liver and in the muscles. The least accumulation took place in the fat.

#### References

- Grodzińska, K. 1987. Mosses as bioindicators of heavy metal pollution in Polish National Parks. *Water, Air and Soil Pollut.* 9: 83-97.