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Heavy Metal Pollution from a Point Source Demonstrated by Mussel (*Unio pictorum L.*) at Lake Balaton, Hungary

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There are numerous sources leading to heavy metal enrichment of the aquatic environment from natural geological weathering to industrial processing of ores and metals (Förstner and Wittmann 1983). Sources for metals in lakes are the atmosphere, riverine inputs and various waste discharges. Among these are "special" sources, for instance the antifouling paints (Anon 1982, Förstner and Wittmann 1983).

Few studies are concerned with heavy metal pollution caused by the use of various paints in water ecosystems. In a study was performed by Bellinger and Benham (1978) on the content of metals in dockyard sediments elevated levels of Cu and Zn from antifouling paints, and Pb from anticorrosive and primer paints were reported. The influence of Cu-oxide and organotin compounds in yacht ports on oyster (Crassostrea gigas) growth and shell morphology has been demonstrated by Alzieu et al (1980).

In the present work a study was performed close to a sailing boat harbor in respect of heavy metal pollution using biological samples. The concentrations of Cu, Zn, Cd and Pb were determined in the organs of freshwater mussel (Unio pictorum L.) by AAS technique.

MATERIALS AND METHODS

The study site was a sailing boat harbour at the town Balatonfüred. Mussel (Unio pictorum L.) samples were taken on November 26, 1982, from the naturally occurring population and for comparison in same season from the open water area, where they occur in the largest amount (Fig.1). The average length of mussels used in the study was 7.62±0.49 cm. The heavy metal concentrations were determined for four organs (gill, foot -including viscera-, adductor muscle and mantle).

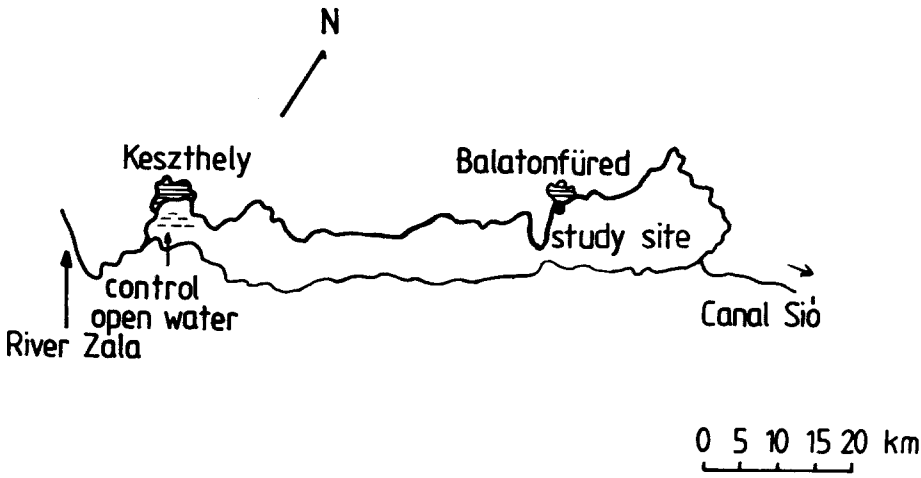

Figure 1. Map of Lake Balaton with study site.

The samples were prepared for analysis by wet digestion. The tissues (about 5-10 g wet wt) were dried at 105°C for 48 h, then digested in the presence of 14 ml of 65% HNO_3 and 7 ml of 30% H_2O_2 for 6h in a water bath with recirculating-type cooler (Krishnamurty et al 1976). The samples were adjusted with tridistilled water to 50 ml, and kept in polyethylene flasks until analysis, to avoid loss of metal ions due to adsorption (Batley and Gardner 1977). Cu, Zn, Cd and Pb concentrations were measured using Zeiss AAS 1 equipment, applying the method of direct flame atomization in air-acetylene flame.
Our data are related to dry weight. The concentrations given in the figures are mean values (±SEM -standard error of mean, n=7).

RESULTS AND DISCUSSION

The mussels living at the area of the sailing boat harbour have strikingly high Cu, Zn, Cd and Pb concentrations in comparison with the animals collected from the control open water area (Fig 2-5). Among the investigated tissues of the gills are most effective at accumulation all of the heavy metals, similarly to that, reported previously for U. pictorum living in the open water of Lake Balaton (Salánki et al 1982). Investigations on the variations of the metal content or concentrations in bivalves show how the organisms react to changes of heavy metal concentrations in their environment (Keckes et al 1968, Bryan 1973, Cunningham and Tripp 1973, 1975, V.Balogh and Salánki 1983). In certain organs of these mussels rather high

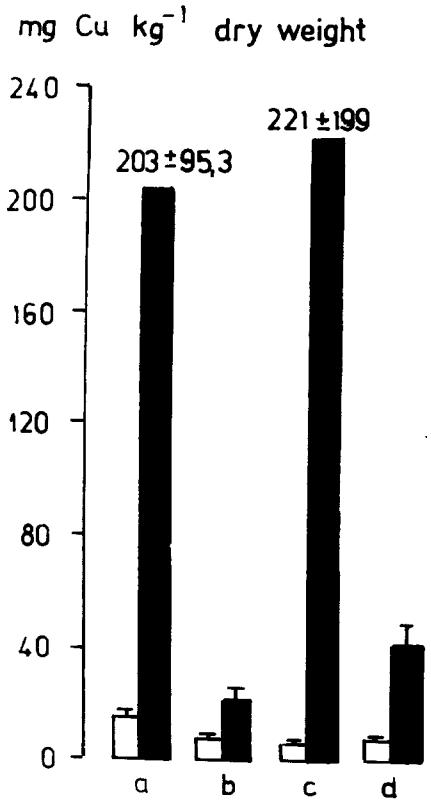

Figure 2.
The concentration of copper in the gill (a), foot (b), adductor muscle (c) and mantle (d) of Unio pictorum L. collected from the open water area (white column) and close to a sailing boat harbour (black column) at Lake Balaton.

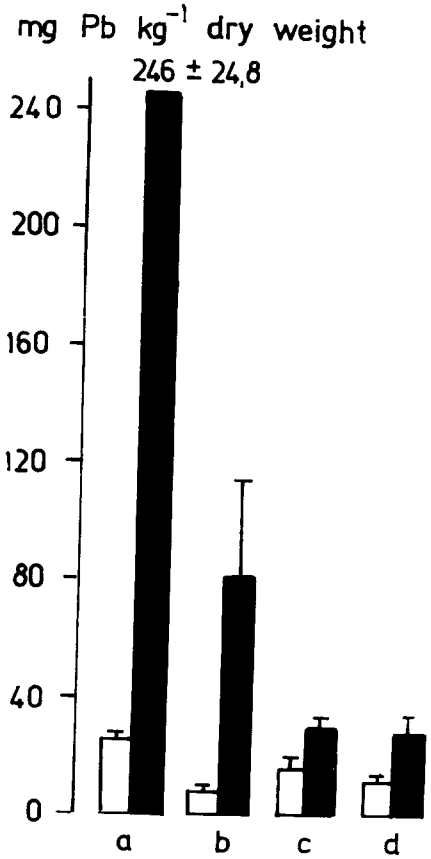

Figure 3.
The concentration of lead

concentrations of Cu, Zn, Cd, Pb were measured and the question arises, what kind of heavy metal pollution source was this caused by? A salining boat harbour being in question, corrosion-preventing and other paints used for the maintenance of the hulls may come into account, among which several contain heavy metals (Table 1).

It should be noted, however, that other products are also widely used for boat painting, (in case of boats in private ownership) the method of application many depart from the manufacturer's instructions.

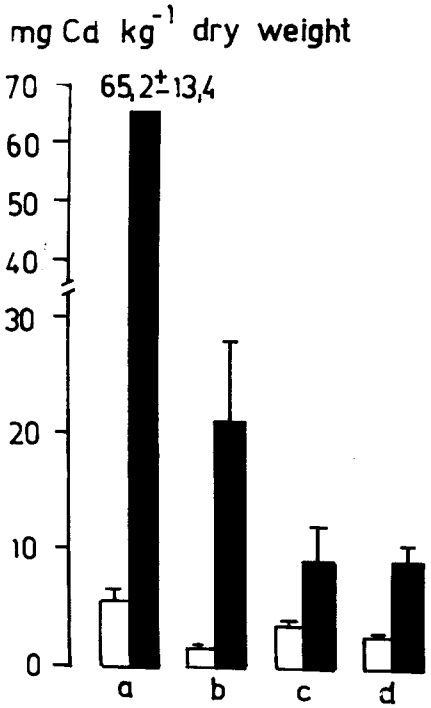

Figure 4.
The concentration of cadmium

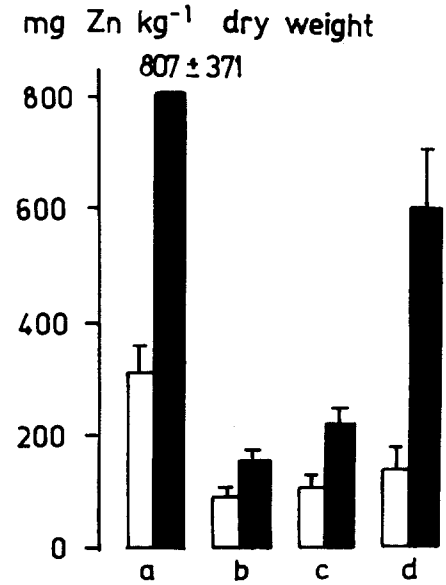

Figure 5.
The concentration of zinc

in the gill (a), foot (b), adductor muscle (c) and mantle (d) of Unio pictorum L. collected from the open water area (white column) and close to a sailing boat harbour (black column) at Lake Balaton.

Table 1. Metal content of a few paints used for the protection of sailing boats

Denomination	Designation	Metal
Rapid zinc-chromating under coating	corrosion preventer	Zn,Cr
Trinat universal under coating	outer coating	Pb
Trinat enamel	outer coating	Pb
Cuprolin antifouling	alga-killing paint	Cu

We may suppose that these mussels with elevated heavy metal concentrations had damaged physiology. It is essential to note that at the time of the study the animals had migrated to be among the stones along the shore, where they were collected. At this time of year, the mussels usually dig deeply into the mud, preparing for winter. The aberrant shorewards migration has not been observed previously.

Our results demonstrate by means of the Unio pictorum L. that the local "special" pollution sources antifouling and anticorrosive paints - may significantly increase the heavy metal concentration in the organisms living at the place where these are used. This, in its consequences, may be harmful to the living world, at least regarding the less mobile species.

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