Biomonitoring of heavy metals in fishpond littorals – their content in aquatic snails, reed stems and bottom sediments

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Introduction

Higher heavy metals input to wetlands can cause serious changes in the ecosystem functioning. Nevertheless, metals cycles and their content in particular components of fishpond ecosystems in central Europe are still not well known. There exist some papers on metals contents in fish tissues, especially in common carp (*Cyprinus carpio*) or in bottom sediments, which mostly describe the situation in pond profundal zone. However, shallow littoral parts with presence of macrophytes are often the most productive zones within the ponds. The aim of this study was therefore to find some new possible bioindicators of heavy metal stress in fishpond littorals. For this research, great pond snail (Lymnaea stagnalis (L.) and common reed (*Phragmites australis* (Cav.) Steud.) were chosen.

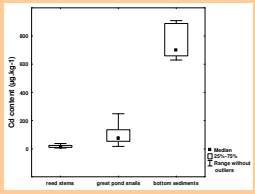
Material and Methods

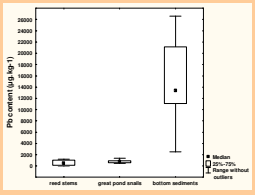
The research was performed during the summer of 2006 on 18 fishponds in two regions of the Czech Republic (see map). The common carp (*Cyprinus carpio* L.) was the most frequent fish stock at all investigated fishponds. Because of intensive fish farming, the fishponds were generally highly eutrophic. Common reed and cattail beds (*Typha* spp.) were the most common macrophyte littoral vegetation there.

In the littoral part of each investigated pond, 2-3 specimens of the great pond snail and samples from about 5 stems of reed from different part of littoral beds were collected. The upper part of about 10 cm of the bottom sediments were collected by hands from various parts of the littoral near the reed beds and pooled sample was created. Samples of snails (without shells), reed and sediments were transported in cooling box to a laboratory.

Determination of the total mercury content in all samples (tissues and sediments) was performed by means of AAS method using a single-purpose cold vapor mercury analyzer AMA-254 (ALTEC Ltd., CZ). Preparation of bottom sediment samples for the determination of Cd and Pb followed ISO 114 66 standard using aqua regia. Determination was performed by AAS flame technique (ZEEnit 700, Analytika Jena, D). Prior to the cadmium and lead determination in tissues by electrothermal AAS, samples were mineralized using nitrogen acid and hydrogen peroxide in laboratory autoclaves with microwave heating (ETHOS SEL, Milestone, I).

Mann-Whitney U test, Kruskal-Wallis Anova and Spearman correlations were used for statistical analysis.





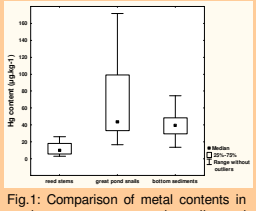
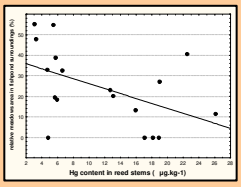


Fig.1: Comparison of metal contents in reed stems, great pond snails and bottom sediments (Mann-Whitney U test; $p < 0.05$)

Results

The contents of Cd, Pb and Hg in all investigated pond littoral components are displayed in figure and table 1. The Cd and Pb values were significantly higher in bottom sediments than in reed and snails. On the other side, the Hg value in snails dry matter was equal to the value in sediments or even higher, which indicate that the great pond snails are suitable for Hg stress monitoring. The differences between the two investigated regions were statistically insignificant. The analysis of the impact of some pond characteristics on heavy metals contents in fishpond littoral components partly proved the importance of the fishpond surroundings and sampling site on our results (see figs 2-3).



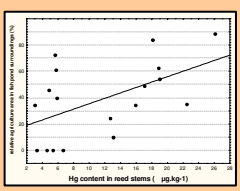
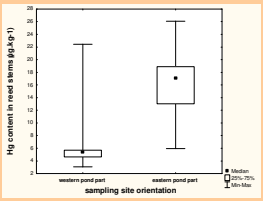


Fig.2: Spearman correlations between Hg content in reed stems and relative meadows and agriculture area in fishponds surroundings ($p < 0.05$)

Tab. 1: Heavy metals content in reed stems (RS), great pond snails (GPS) and bottom sediments (BS); n = 18

Cd (µg.kg-1) - median			Pb (µg.kg-1) - median			Hg (µg.kg-1) -median		
RS	GPS	BS	RS	GPS	BS	RS	GPS	BS
13.92	74.44	700.00	507.81	807.19	13410.00	9.65	43.41	39.57



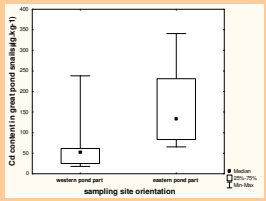


Fig.3: Heavy metals contents in reed stems and great pond snails in connection with location of sampling sites. Higher contents in eastern pond parts indicate higher accumulation there because of prevailing winds from the north-western direction.

Conclusions

Preliminary results of this study indicate a good bioindication potential of great pond snail for heavy metals stress in fishpond littorals, especially for mercury. The recorded heavy metals values in reed stems, great pond snails and bottom sediments can serve for comparison with values from more contaminated wetland localities in further studies. Some environmental factors, including pond surroundings and orientation of sampling site can largely influence results of such type of research, thus further studies are necessary.

Acknowledgments

This study was supported by the Ministry of Education of the Czech Republic (projects no. MSM 6215712402 and MSM 0021622416).