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BRIEF COMMUNICATION

Concentrations of trace metals in dominant aquatic plants of the Lake Provala (Vojvodina, Yugoslavia)

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Abstract

The trace metal (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Sr, and Cr) contents in the most common submerged and floating aquatic plants *Ceratophyllum demersum* L., *Myriophyllum spicatum* L., and *Nymphoides flava* Hill. of Provala Lake were evaluated. Considerable higher contents of iron, manganese, zinc, nickel, lead and strontium were found in submerged species than in the floating ones. The presence of cadmium and lead in plant tissues points to a certain degree of lake water pollution.

Additional key words: *Ceratophyllum demersum*, macrophytes, *Myriophyllum spicatum*, *Nymphoides flava*.

Vascular aquatics may accumulate considerable amounts of heavy metals in their tissues (10 - 10^6 times those in nearby water environment) (Kovács *et al.* 1984). Therefore, macrophytes play an important roles in heavy metal cycling in an aquatic ecosystem: direct (bio-concentration) and indirect (slow down of water stream flow accelerating sedimentation of dispersed particles and metal ions) (St-Cyr *et al.* 1994). Metal bioaccumulation depends upon plant species, its organs, and numerous abiotic factors, temperature, pH, transportation of metal-contaminated particles and dissolved ions in water (Lewis 1995, Lewander *et al.* 1996). Their ability to accumulate chemical elements as well as their remarkable production of organic matter in aquatic ecosystems make macrophytes "*in situ*" indicator species of water quality (Abo-Rady 1980, Manny *et al.* 1991). Such a role of macrophytes is strengthened by significant interspecific variability of nutrient concentrations in plant tissues (Boyd 1970, Gupta 1998).

In this investigation the concentration of trace metals (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Sr, and Cr) in the most common submerged and floating aquatic plants in the Lake Provala was determined. The Lake Provala is situated in southwestern Vojvodina (45°29' latitude and 18°86' longitude). It extends from northeast to southwest being 390 m long, while average width of its northern rounded part exceeds 140 m. The maximal depth is 18 m. The lake was formed during great floods in 1924. The lake is a closed ecosystem and receives water mainly from the Danube river by subterranean streams and precipitation.

Plants were collected from randomly selected sites at maximum development stage and the peak seasonal biomass (June - August) during two years 1996 and 1998. After final rinsing in distilled water, material was dried and prepared for analyses following standard methods for the examination of water and wastewater (Franson 1995). The total metal concentrations were determined by atomic absorption spectrophotometry. Data were analyzed by Duncan's multiple range test, and testing was done for the level of significance $P = 0.05$.

Regardless of the differences in absolute values recorded in different years of investigation, an evident intergenus specificity distinguishing submerged species *Ceratophyllum demersum* and *Myriophyllum spicatum* from the floating aquatic *Nymphoides flava* in significantly higher content of iron, manganese, zinc, nickel, lead, and strontium in particular, was observed (Table 1).

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Table 1. Average contents of trace metals in aquatic macrophytes during two years [μg g^{-1}(d.m.)]. Values with the same letter do not differ significantly at $P = 0.05$, $n = 8$.

Year	Species	Fe	Mn	Zn	Cu	Ni	Pb	Cd	Sr	Cr
1996	*C. demersum*	2111.7a	315.0a	132.0a	5.0a	1.8b	38.3a	0.0	141.7b	-
	M. spicatum	1831.7b	166.7b	132.0a	3.3b	8.3a	38.3a	0.0	591.7a	-
	N. flava	650.0c	61.7c	72.7b	1.0c	0.8b	31.7b	0.0	36.7c	-
	$LSD_{0.05}$	212.0	18.7	25.8	1.7	2.8	5.5	-	66.3	-
1998	*C. demersum*	1325.0a	366.7a	26.7a	5.3a	18.5a	60.2a	2.5a	380.3a	11.8a
	M. spicatum	1325.0a	163.3b	18.0b	4.5ab	16.8b	65.5a	2.3a	362.0a	10.0a
	N. flava	441.3b	51.7c	18.3b	4.3b	6.3c	32.2b	0.8b	87.3	6.5a
	$LSD_{0.05}$	246.5	7.4	3.0	0.9	1.3	17.4	0.4	33.2	6.3

Table 2. Average contents of trace metals in mud and water of Provala lake [μg g^{-1}(d.m.)].

		Fe	Mn	Zn	Cu	Ni	Pb	Cd	Sr	Cr
Mud	south-east	3562.5	23.00	30.25	6.25	22.75	43.50	2.0	57.5	23.25
	north-west	6875.0	35.70	51.75	9.25	36.25	50.75	2.0	65.0	29.75
Water	south-east	0.35	0.04	0.02	0.01	0.01	0.02	0.0	0.2	0.02
	north-west	0.92	0.04	0.03	0.01	0.02	0.08	0.0	0.2	0.00

Higher concentrations of all the investigated elements were found in mud from a deeper, northwestern part of the lake (Table 2). Mud concentrations of the most investigated elements were many times higher than those of water.

The presented chemical composition of dominant macrophytes from Lake Provala, provides the first picture of recent ecological conditions of this ecosystem. The impact of heavy metals on Lake Provala was reflected in aquatic plants. By comparing our results with those reported for similar water ecosystems (Kovács *et al.* 1984), higher lead concentration was found in *M. spicatum* from Lake Provala, whereas the contents of the remaining analyzed metals were smaller. Low manganese, zinc, copper and nickel contents in both plant tissues and water environment show low pollution, but elevated Pb concentrations in mud, water, and plants as well as detected Cd in mud and plant tissues point to its initiation.

Our results of higher metal contents in submerged compared to that of floating plants are in agreement with those of Manny *et al.* (1991), (Stanković *et al.* 1994), and Samecka-Cymerman and Kempers (1996). Our results, besides the other parameters, could be used in monitoring water quality.

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