



Eutrophication process in the Plitvice Lakes water – anthropogenic pollution or natural process?

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The Plitvice Lakes situated in the Dinaric Karst, Central Croatia, consist of series of 16 lakes at different levels separated by tufa barriers and waterfalls. The process of calcium carbonate precipitation in water streams/lakes in form of tufa is very intensive in this area. At the same time this process, which depends on physico-chemical conditions and also on biological component (presence of macrophytes and microphytes), is very sensitive to any kind of water pollution. In the last decades the process of eutrophication has been developed and is in progress in some of the lakes. It can be the result of some contaminations/input of nutrients in the lake water. Although the Plitvice Lakes are protected as the national park, there is possible contamination due to high turistic activity, and due to the input of nutrients from the humus/leaves from the surrounding forests.

In this work we present the results of surface water measurements in the Plitvice Lakes area including 4 springs, 5 lakes and 6 water streams between lakes. In two largest lakes the measurements in vertical water profiles were also performed. Eutrophic and non-eutrophic waters were sampled. The measurements were performed in different seasons in the period 2003 – 2005. The following parameters were measured: *in situ* – temperature, pH, conductivity and oxygen concentration; in laboratory – cations (Ca^{2+} , Mg^{2+} , K^+ , Na^+), anions (HCO_3^- , SO_4^{2-} , Cl^- , F^-), trace elements (B, Al, Cr, Sr, Mn, Fe, Ni, Cu, Zn, Cd, Ba, Pb), nutrients (NO_3^- , NO_2^- , HPO_4^{2-} , NH_4^+) and dissolved organic carbon (DOC). Additionally, we did some chemical measurements of percolating water in wood soil (collected by lysimeters).

We calculated saturation index of calcium carbonate (I_{sat}) using measured values of

temperature, pH, calcium and bicarbonate concentrations. I_{sat} values show that water is supersaturated in respect of calcium carbonate in all areas where tufa precipitates and it is independent on the eutrophication level of the area. There is also no significant difference between trace elements and nutrient concentrations between eutrophic and non-eutrophic waters. Most of concentrations are low or even below detectable limit, e.g. NO_2^- , HPO_4^{2-} , Cd, Cr, Cu, Mn, Ni, Pb. The highest difference is noticed in DOC concentration: in non-eutrophic water DOC concentration is below 1 mg/L and in eutrophic water is 1-2 mg/L. Significantly higher concentration of DOC (25-40 mg/L) was measured in percolating waters collected at 3 different locations covered with forest (beech, fir and juniper wood). Concentration of nitrates was also significantly higher in percolating waters (4-20 mg/L) than in either eutrophic or non-eutrophic waters (2.5 – 4.5 mg/L).

According to the presented results we can conclude that there is no significant influence of anthropogenic pollution on the water, neither in non-eutrophic nor in eutrophic water. Higher concentration of DOC in eutrophic water can be a consequence of input of natural organic matter, mainly supported by the percolating waters from the surrounding forest humus, to the lake water.