

# Long term monitoring of marina Punat

<sup>1</sup>M. Kutle, <sup>1</sup>A. Kutle, <sup>2</sup>P. Barši, <sup>3</sup>V. Valković, <sup>3</sup>J. Obhodaš

<sup>1</sup>Association LijepaNaša, Heinzelova 6/II, Zagreb, Croatia

<sup>2</sup>Marina Punat Ltd., Puntica 7, Punat, Croatia

<sup>3</sup>Institute RuderBošković, Bijeničkacesta 54, Zagreb, Croatia

Phone: +385915300697

E-mail:udrugalijepanasa@gmail.com

**Introduction:** Knowledge on pollution levels is essential to define environmental protection measures and to adopt appropriate action plans. Sediments are probably the best indicator of the quality of the marine environment because they accumulate contaminants from the water column over the long period of time. This can be used to assess the present exposure to contamination, as well as to gather evidence on past contamination events and to reconstruct a historical record of pollutant discharges. It is known that sediments in marinas have elevated concentrations of heavy metals such as Cu and Zn which are used as biocides in antifouling paints for boats. Here we present an example of good management practice for achieving higher environmental standards.

**Methods:** Croatian marinas are obliged to conduct monitoring of the sea water column and surface sediments in line with the Croatian Regulation of water classification NN 77/98, NN/137/08, Regulation on Sea bathing Water quality NN 73/08 and Water Framework Directive 200/60/EC. Monitoring in marina Punat is organized four times per year at three locations within marina and one control point outside the marina (Fig1).

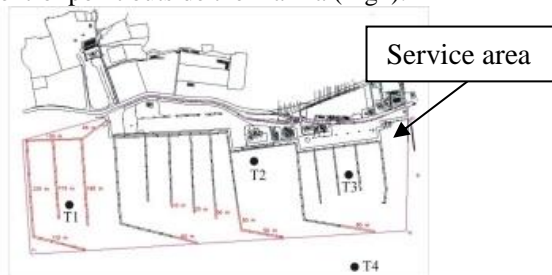


Fig. 1: Sampling points

**Results:** Results for water temperature, conductivity, dissolved oxygen, pH value, microorganisms (coliforms, fecal coliforms, intestinal enterococci) in surface and bottom layer, and mineral oil in the surface layer, as well as concentrations of several elements in surface sediments (arsenic, chromium, copper, mercury, lead, nickel and zinc) are presented for the period 2009-2018.

**Discussion:** A significant improvement in the quality of sediments has been observed after deploying the waste water plant in the marina's service area. Concentrations of copper in surface sediments have dropped from 10,030 ppm in 2005 to 124 ppm in 2013 at the location next to the service area (not the

monitoring point) where boats are washed in order to remove old antifouling paint. The effect is observable even at the control monitoring point T4 (Fig 5), although marina Punat since then has increased the number of berths for 10 %.



Fig. 2: Sampling point T1



Fig. 3: Sampling point T2

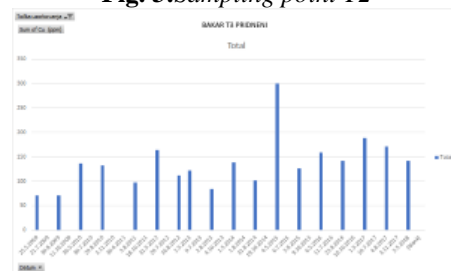


Fig. 4: Sampling point T3

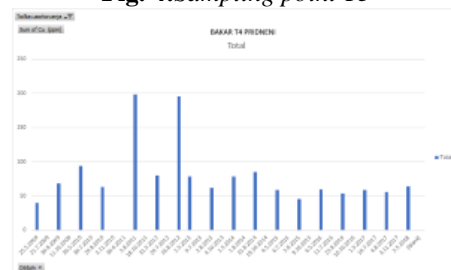


Fig. 5: Sampling point T4