

AN IMPACT OF NAUTICAL TOURISM ON COPPER CONCENTRATIONS IN THE KRKA RIVER ESTUARY (CROATIA)

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Abstract

To evaluate impact of nautical tourism on copper concentrations in surface layer of Krka River estuary (Croatia), one-year monitoring was established. Monitoring consisted of two main activities: 1) counting vessels by video observing and 2) measuring copper content in water. The conducted research confirmed strong relation between nautical tourism and copper concentration in water.

Keywords: Trace elements, Surface waters, Estuaries, Coastal waters, Central Adriatic Sea

Introduction

Copper (Cu) is a micronutrient required in a number of cellular processes that are key for phytoplankton growth. As phytoplankton is the first level of the food chain, deficiency in copper can lead to numerous unfavourable biological conditions in the sea ecosystem. At physiologically high concentrations, copper is toxic and may affect both planktonic abundance and diversity in coastal waters. Range of copper concentrations between these two extremes is relatively narrow [1, 2, 3]. Copper contaminates coastal waters mainly by anthropogenic inputs. It is used as an anti-biofouling agent with Cu-based paint covering the hull of boats, releasing considerable quantity in coastal waters. The areas which are potentially endangered are those with high copper input and weak water exchange. One of these potentially endangered areas is the Krka River estuary protected as NATURA 2000 site. Preliminary studies carried out in last several years, have showed that during summer season concentrations of copper could be 20 times higher compared to winter season [4]. Unfortunately, there are no data available for number of vessels (per day/month/year) in the Estuary. To evaluate relation between copper contents in water, the number of vessels during one-year period and other parameters such as salinity, rainfall, Krka River flow, wind strength and direction, a monitoring survey has been established.

Methodology

Monitoring system was based on the two main activities: (1) video surveillance/observing system for vessels counting, (2) monitoring of copper content in water. Video surveillance system consisted of video camera that was monitoring the entrance to the estuary and software which provided continuous information about entrance/exit and statistics of the vessels (hour, day, month, year). As a part of second monitoring activity, surface water samples have been collected every 2-3 days within the estuary. Voltammetry was used for copper measurements. Furthermore, salinity was measured in each sample and meteorological and hydrological data were collected.

Results

Results of counting vessels system have shown significant differences between number of boat passes during winter and summer season (~50/day to ~1100/day). Moreover, obtained copper concentrations demonstrate clear distinction between winter and summer values (min/max: 3.8/19.2 nM of Cu). The established monitoring has confirmed strong relation between the nautical tourism and concentrations of copper in surface layer (Fig. 1).

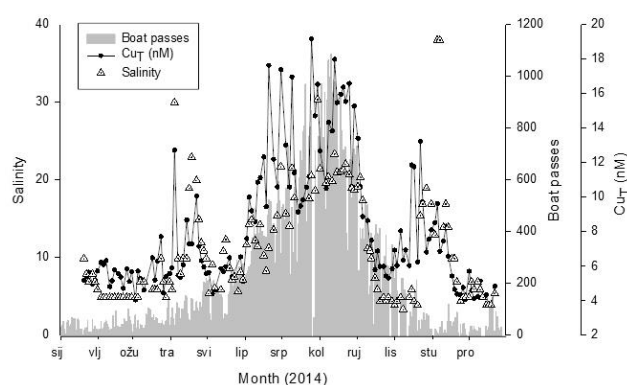


Fig. 1. Boat passes, salinity and copper concentrations in surface layer of the Krka River estuary

Additionally, it was estimated that other factors, such as salinity, the Krka River flow and wind strength and direction have additional influence on temporal copper distribution. The results from this study can be used as support in planning sustainable tourism in this, as well as in other protected areas.

References

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