



Coastal groundwater stable isotope composition as predictor and measure of marine pollution

Diana Mance¹, Davor Mance², and Darija Vukić Lušić^{3,4}

¹University of Rijeka, Department of Physics, Rijeka, Croatia (diana.mance@uniri.hr)

²University of Rijeka, Faculty of Economics, Rijeka, Croatia (davor.mance@efri.hr)

³Teaching Institute of Public Health of Primorje-Gorski Kotar County, Department of Environmental Health, Rijeka, Croatia (darija.vukic-lusic@zzjzpgz.hr)

⁴University of Rijeka, Faculty of Medicine, Department of Environmental Health, Rijeka, Croatia

There are numerous health hazards arising from recreational exposures to microbiologically polluted marine environments. Microbial contaminants from catchment areas of coastal and submarine springs (due to leakages of private septic tanks and/or faults in sewage systems) could be a cause of microbial marine quality worsening after heavy rainfalls. Before testing this hypothesis groundwater dynamics should be known. Stable isotopes of water have been proven to be a very useful tool in karst hydrology and we used them as a mediator variable in predicting marine coastal water microbial contamination.

We refer to the problem of the pollution from the position of environmental economics and economic institutional mechanism design, where such ecological problems are described as either stock or flow problems. Stock pollution is strongly dependent on the concentration potentials of the pollutant in the medium. Flow pollution depends on the speed of emission of the pollutant in the medium, as well as on the rate of its depletion by natural causes. On the example of fecal indicator bacteria *Escherichia coli* and enterococci propagating through karstic underground and finally ending in seawater we show how stable isotope composition of coastal springs' water can be used to differentiate marine pollution into stock or flow.

We tested the approach on two close coastal locations located at the Kvarner Bay (the Northern part of the Croatian part of the Adriatic Sea). Locations differ in terms of the open and closed sea as well as anthropogenic pressure. Groundwater and marine samples were collected during two consecutive bathing seasons (mid-May – mid-September). The Panel Data Pairwise Granger Causality test was used to test for statistical associations. Static Estimated General Least Squares (EGLS) and dynamic Generalised Method of Moments (GMM) statistical methods were used to distinguish between stock and flow pollution.

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