



Hydrological functioning of three karst springs located in the Cetina River catchment in Croatia

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The Cetina River catchment covers the area of about 4140 km². The entire catchment is placed in karst terrain formed of very thick layers of limestones and dolomites with intensive karstification and complex hydrogeological conditions. The Cetina River is a typical example of rivers in deep karst region, where the surface watershed does not coincide with subsurface watershed. The catchment is composed of two different areas. It partly lies in the mountain region while the other morphologically belongs to the karst poljes area. The recharge area covers the Sinjsko Polje as well as the system of higher elevated poljes: Kupreško Polje, Duvanjsko Polje and Livanjsko Polje together with Buško Blato, including their mountainous margins with peaks reach over 2000 m a.s.l. Water circulates between poljes through underground karst channels. The whole area is the typical karst terrain. The carbonate rocks have the dominant influence in the formation of the drainage basin so the large part of the area has no surface waters. The karst circulation velocities vary in a wide range between 0.002-55.2 cm/s depending on the hydrologic period and water table position. The slow movement of water is characteristic for the dry season. The flow regime of Cetina River displays maximum during period of autumn, a secondary one during spring, and a minimum in summer. During dry periods the river loses water through the ponors inside the area of the riverbed. There are numerous permanent springs in the vicinity of Cetina riverbed along the Sinjsko Polje which show a visible correspondence with ponors located in the Livanjsko Polje. Temporary karst springs are mostly characteristic of the canyon part of the river. Generally, the springs in the Cetina River basin can be divided into two groups. The first group includes the springs in the deposits and the other group includes the springs which get their water from carbonate rocks at contacts with the impermeable marl rocks. During the period between 1960 and 1985, five hydropower plants were built in the Cetina River catchment, which strongly influenced natural hydrological regime of the river and the whole area. The subjects of interest of this study are three karst springs: Rumin Veliki, Rumin Mali and Ruda Velika. The development and operation of hydropower plant Orlovac in 1973 including two reservoirs constructed in the Livanjsko Polje: Lipa and Buško Blato, changed significantly minimal, maximal and total discharges from these three springs. The distribution of water towards the springs was changed in a different way representing a good example of how human interventions in karst can produce unexpected results. The main objective of this study is investigation and comparison of hydrological functioning of three analysed springs during the period after construction of the hydropower reservoirs Lipa and Buško Blato in order to understand better the hydrological consequences of their operation. The analysed time series are daily and hourly discharges from the springs as well as daily rainfall, relative humidity and temperature from meteorological stations Sinj and Livno.