

THE TAMED RHÔNE RIVER (FRANCE): TRAINING, MANAGEMENT AND RECENT RESTORATION OF AN IMPACTED RIVER OF WESTERN EUROPE

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RESUMO: The Rhône River (France) is a short (530 km long) and high-energy river with an average discharge of 1700 m³/s at its deltaic mouth. Tectonics, heritages of quaternary glaciations, and Holocene climate changes are the main factors explaining the upstream-downstream variations of the river continuum, which displayed dominantly a braided pattern in the mid-19th century. The Rhône has been trained (1) for navigation between 1860 and 1939, and (2) for the production of hydropower between 1892 and 1986. Also this river cools several nuclear power plants. The first engineering works were levees and low dykes built along and inside the river bed to constrict the channel and improve the conditions of navigation; the second generation of works consisted of dams, canals and power plants, and of the by-passing of some reaches built by the National Rhone River Company. The by-passed reaches, also called "old Rhone", drain a minimum ecological discharge, except during floods when discharge is almost natural (flood discharge may last from several days to several weeks). River dynamics in the by-passed reaches resulted in the deepening of the gravel riverbed and in the deposition of sand and silts beyond the low dykes, which restricted the width of the former braided active tract. Due to this deposition, and following recent floods (1993-1994, 2002-2003), flood levels have increased since the mid-19th century, which was detrimental to riverine activities on the floodplain. The negative impacts of siltation inside the side arms then require dredging to compensate for to the reduction of flow capacity. This policy has been performed since the 1980's along with ecological measures. However it has been proved too limited to accommodate the volume of deposition. An interdisciplinary study is in progress since 2003 through different programs involving several partners. An innovative methodology has brought together into a GIS : (1) the historical changes of land occupation in the former active tract since 1860, (2) the location of all dykes and levees, (3) the delineation of homogeneous land units prone to sedimentation, (4) the estimation of the thickness and volumes of deposits, (5) the grain size analysis, (6) the pollution (notably heavy metals, PCB) of the sediments, (7) the computation of tractive forces in selected areas to assess the possibility of lateral erosion during floods. Indeed, this project aims at removing sediments in excess by using the energy of the floods after limited preparation work (i.e. removal of old dykes along the channel). The first project, limited to a reach inside one of the by-passed reaches, has been submitted to State authorization, and accepted. A flood, which occurred in 2009, proved its efficiency to erode the banks. The widening of the Rhône river having been elected as part of the Rhône Master plan, a directory scheme is being prepared for extending local operations of widening to the complete set of by-passed reaches along the continuum.