



## **NARROWING AND BED INCISION OF A COBBLE BED RIVER IN CENTRAL ITALY**

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The paper describes the results of a GIS implemented study about morphological, sedimentary and human characteristics of the River Paglia riverbed (River Tiber watershed, central Italy). The aims are to characterize the present riverbed conditions, to define the evolutionary trend of the whole alluvial plain - riverbed system (heavy conditioned by human activity) and to assume criteria for a correct management of the fluvial system itself. The River Paglia's watershed, one of the main tributaries of River Tiber, extends over Tuscany, Latium and Umbria Region and measures 1,320 km<sup>2</sup> as total area; the studied reach is the umbrian one, measuring 22 km in length. The work was primarily carried out by means of a geomorphological survey of the riverbed. During this phase the main geometric, hydraulic and sedimentary parameters were measured in correspondence of 14 cross sections; in addition, a grain-size characterization of the bed material, carried out by means of pebble count and photographic sampling, was produced. The collected data were input in a geographic database, that is an extremely useful tool to analyse the conditions of the riverbed, to input correctly the spatial data and to manage and to visualize them. An historical analysis was carried out, which enabled the authors to characterize and to quantify the morphological-planimetric variations of the alluvial plain - riverbed system during last 200 years. Also this phase was conducted in GIS environment, by means of a procedure (based on the geocoding, digitalization and measurement of interesting parameters), similar to that used by other researchers (Donward et alii, 1994; Leys Werrity, 1999; Winterbottom, 2000; Werrity Leys, 2001; Surian, 2002). The results shows that the width of the active riverbed was progressively reduced (from 206.7 m in 1821 to 53.9 m in 1999); so the braided index (from 1,40 in 1977 to 1,21 in 1999); the lateral displacement was mainly towards the left bank (about 121 m between 1821 and 1977). So it

is evident that, as observed by many authors about other Italian and European rivers (Cencetti et al., 1992; Bravard et alii, 1997; Rinaldi Simon, 1998; Surian, 1999; Winterbottom, 2000; Surian, 2002, Arnaud Fassetta, 2003; Surian e Rinaldi, 2003), the River Paglia shows a marked tendency to downcutting, with a reduction in width of the active riverbed area. In particular, there is a long intermediate segment (about 8 km in length) where the thalweg is incised with continuity into the bedrock (pliocenic clays); the banks show the clayey bedrock outcropping for about 2 metres in thickness. Only sporadically you can note small sedimentary bodies (bars) due to the material coming from the erosional processes of the banks. Downstream this segment, the River is very incised into its suspended alluvial plain and it shows a cobble riverbed related to the process of stabilization produced by some transversal works and by the coarse sediment supply from the slopes. This work let to value the activity of some present processes: bank erosion: GPS measurements showed that, where the banks are eroded, the regression rate is similar to that obtained from historical analysis (about 3-6 m/year); vertical erosion: considering that the quarrying activity, surely carried out in the '60, produced the outcropping of the bedrock, the authors estimate the rate of vertical erosional process at about 5 cm/year, which determine the existing incision into the clayey bedrock. The erosional process and the reduction in width of the riverbed active area was triggered by quarrying activity and then such processes accelerated due to a positive feedback mechanism

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