



Contemporary pattern adjustments of Putna River's channel (South - Eastern Carpathians) reflected by cartographic materials

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Putna is an approximately 160 km long Romanian river draining the south-eastern part of Carpathian Mountains. The extensive deforestations recorded before the 1950 in the upper part of its catchment have undoubtedly affected river channel planform typology due to the high rates of slope erosion and associated sediment input. After this period, an ample process of reforestation was initiated that limited soil erosion to a great extent. This determined further river channel adjustments as an effect of the boost in the energy of the stream discharge. However in scientific literature there are just a few established evidence and observations on these transformations.

In order to determine the trend of channel adjustments we analysed three sets of topographical maps edited by the Romanian Army's Geographical Service in 1891-1901, 1961-1962 and 1981 (in scale 1:20 000 or 1:25 000), as well as some satellite and aerial images (Landsat, Corona, orthophotos). These cartographic materials were basis for creating a digital database, with the typology and position of the river channel during each historical stage for almost the entire valley length. Automatic measurements on channel sinuosity and braiding indices (based on the method used by Friend and Sinha, 1993) were performed for 121 one-kilometer sections.

Along river channel, the coefficient of sinuosity showed a gradual decrease of the maximum values (3.7 at the end of 19th century, 3.4 in 1960, 3.2 in 1980 and 2.9 in 2003), but in terms of frequency, the trend is reversed, with more and more sections showing an increased index. A simple analysis of the sinuosity index variation, defined in classical manner, however, proved ineffective for relation to influencing factors (there may be similar values for different width values of the river floodplain). Hence we reevaluated the formulation of an index to show the percentage deviation of a riverbed from a straight course, the differences between valley sinuosity and river sinuosity and the importance of local topography. Applying these indices in the study of river sinuosity changes in the Putna Valley between 1890 and 2003, a continuous increase in the difference between the sinuosity of the river and that of the valley was found. This can be related to the influence of hydrological processes (lateral migration) on the plan form of the river channel.

Similar to the evolution of the sinuosity index, the variation of the highest braiding index values (3.5 at the end of 19th century, 4.3 in 1960, 4.6 in 1980 and 3.9 in 2003) was found less significant compared to the frequency of certain classes. Based on the latter indicator, we concluded that there has been an overall decrease of braiding values during 1960 – 2000, accompanied by a similar decrease of surfaces occupied by depositional bars (in case of channel bars and islands – from approx. 700 ha at the end of 19th century to less than 500 ha in 2003).

In conclusion, analysis of channel planform adjustments of the Putna River for the last century indicates an overall increase in the river's lateral dynamics and channel sinuosity comparative with braiding index. This may come from the evident decrease in the river's sediment discharge due to the massive reforestations.