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Geomorphological evolution of a river-reach following an intense gravel extraction: the Ésera river at Perarrúa (Spain)

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Physical processes in rivers are the result of the interaction between flow regime and hydraulics, morphology, sedimentology and sediment transport. The frequency and magnitude of physical disturbance (i.e., bed stability) control habitat integrity and, consequently, ecological diversity of a particular fluvial system. Most rivers experience human-induced perturbations that alter such hydrosedimentary equilibrium, thus affecting the habitat of aquatic species. A dynamic balance may take long time to be newly attained. Within this context, gravel mining is well known to affect channel characteristics mostly at the local scale, but its effect may also propagate downstream and upstream. Sedimentary forms are modified during extraction and habitat features are reduced or even eliminated. Effects tend to be most acute in contrasted climatic environments, such as the Mediterranean areas, in which climatic and hydrological variability maximises effects of impacts and precludes short regeneration periods. Present research focuses on the 3-yr evolution of a river reach, which experienced an intense gravel extraction. The selected area is located in the River Ésera (Ebro basin), where interactions between morphodynamics and habitat recovery are examined. Emphasis was put on the evaluation of sedimentary, morphological and hydraulic variables to later compare pre (t0) and post extraction situations (t_1, t_2,..., t_n). Methodology included: i) grain size distribution characterization, ii) description of channel morphology by means of close-range aerial photographs and iii) determination of flow parameters.

Consequences of the gravel extraction, by comparing the aerial photos of the pre and post extraction situations, resulted in the elimination of the central bar, which was stable and partially vegetated, together with 2 smaller bars located upstream. However, it can be observed a tendency to recover the initial geomorphology. Comparisons of the DEMs (i.e., DoD) provided a reduction in height of up to 2 m, while accumulations of ca. 1.5 m were observed at some places. DoD allowed to calculate in ca. 5000 m^3 the total volume of sediment extracted, although a large part of these lost sediments have been already redeposited. Several changes can be seen in the results obtained by the hydraulic simulation; due to the elimination and recovery of the central gravel bar the submerged bed-surface and the width of the reach, for a first increase (and later loss) and a clear reduction (and later increase) of velocity and depth.