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Impact of gravel mining on benthic invertebrate communities in a highly dynamic gravel-bed river: an integrated methodology to link geomorphic disturbances and ecological status

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Water and sediments are transported along river channels. Their supply, transport and deposition control river morphology and sedimentary characteristics, which in turn support habitat. Floods disturb river channels naturally although anthropogenic impacts may also contribute. River channel disturbance is considered the main factor affecting the organization of riverine communities and contributes to key ecological processes.

In this paper we present an integrated methodology designed to analyze the impacts of in-channel gravel mining on benthic invertebrate communities. The study is conducted in the Upper River Cinca (Southern Pyrenees). A 11 km river reach is being monitored in order to understand the effects of floods and gravel mining on channel morphodynamics and invertebrate communities. The study reach is located in and upland gravel-bed system historically and currently affected by periodical episodes of in-channel sediment mining. This methodology has been developed in the background of the research project MorphSed.

An integrated methodology of four components (Co) has been designed and is being implemented: (Co1) acquisition of high resolution imagery to generate topographic models before and after channel disturbances. Floods and in-channel gravel mining are considered natural and anthropogenic disturbances, respectively. Topographic models are obtained by means of combining automated digital photogrammetry (SfM) and optical bathymetric models. Event-scale models are used to assess the spatial extent and magnitude of bed disturbance. (Co2) Invertebrate sampling in 5 representative reaches along the study site. Invertebrate surber samples are providing data to define assemblages and their characteristics (composition, density, distribution, traits). These data is used to assess the spatial extent of channel disturbance impacts on the taxonomic and trait structure of communities. (Co3) Monitoring flow and sediment transport in the upstream and downstream ends of the study site. These data is providing information regarding to the magnitude of flood events (including hydraulics) and the sediment budget in the study reach. Special emphasis is giving to the role of gravel mining in increasing fine sediment availability and bed mobility. Finally, (Co4) a statistical treatment of the data sets will be applied in order (i) to develop invertebrate-based metrics to analyze the impact of bed disturbance and their recovery, and (ii) to determine the most suitable physical metrics for detecting responses on benthic invertebrates. These multi-event data sets will be a key goal for progress towards the system-scale understanding of the interactions between river disturbance and ecological responses, and provide the basis for an integrated methodology that can be used to aid prediction, management and restoration of human stressed fluvial systems.