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Geomorphological evolution of a newly restored upland temporary stream

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The river Ehen, NW England, has been designated as a Special Area of Conservation (SAC) as it hosts England's largest population of freshwater pearl mussels (M. margaritifera). One of the Ehen's main headwater tributary, Ben Gill, was diverted to Ennerdale Lake in the 1970s to help increase the volume of water available for abstraction. Concerns over this diversion on the hydrology and sediment dynamics of the Ehen has led to the reconnection of this temporary stream as part of a project designed to improve habitat conditions for mussels in the Ehen. The reconnection has involved the construction of a new section of channel, following the natural (pre-diversion) course of Ben Gill.

This paper presents findings of research designed to track the morphological evolution of the newly created Ben Gill channel. The work follows a previous research in which fluvial dynamics in the Ehen were studied before the reconnection of Ben Gill. Morpho-sedimentary dynamics are analysed at multiple scales: from the movement of individual particles, to changes on channel morphology following competent flow events. Changes in the channel's grain size distributions have been investigated in different sections, while bed mobility has been assessed using a combination of radio frequency identification (RFID) tags inserted into representative particles and painted bed patches. Additionally, digital elevation models (DEMs) of the entire new channel have been constructed by means of automatic digital photogrammetry using high resolution aerial photography taken by an unmanned aerial vehicle (UAV). DEMs of difference (DoD) between major flow events have been used to track lateral and longitudinal changes in the channel at a spatial resolution of less than 5cm. Finally, in order to link sedimentological changes in the new channel to its impact on the main stem Ehen, morpho-sedimentary changes of a gravel bar at the confluence have been monitored combining tracers (i.e. RFID) and repeated topographic surveys (i.e. automatic digital photogrammetry).

This paper reports how the integration of these complementary approaches are providing important insights into the evolution of this new channel and its sediment budget, and in turn, what effects its reconnection are likely to have on sediment availability in the Ehen. Understanding these geomorphic processes is critical for assessing the benefits of the reconnection for the Ehen's mussel population.