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The potential of localized woodland planting to address coarse sediment delivery problems in gravel-bed rivers

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Activities traditionally adopted to manage river instabilities following from high rates of coarse sediment delivery (e.g. dredging, river channel narrowing and/or straightening) are increasingly recognized as conceptually flawed, unsustainable and leading to negative ecological impacts. This paper shows the crucial role that native woodland replanting might play as an alternative strategy to managing such instabilities through eventual reductions in coarse sediment delivery rates. The research is based upon evidence from: (1) an intensive instrumentation of an upland river catchment using both traditional hydrometric and novel sediment sensing methods; and (2) a sediment delivery model that combines a treatment of sediment generation from mass failure with a treatment of the connectivity of this failed material to the drainage network, and which has been subject to detailed validation. For a 76km^2 demonstration catchment, the analysis shows that approximately 85% of coarse sediment delivery was found to be associated with only four of the thirteen associated sub-catchments and the areas of these sub-catchmes actually delivering sediment to the river system was generally lower than 1%. Much of this was because of the crucial regulating role played by hillslope hydrological connectivity which resulted in only a small proportion of sediment generating sources actually connecting with the drainage network. Simulations were then undertaken that showed that highly localized planting of native woodland in key tributaries could reduce coarse sediment delivery rates by approximately 80%, leading to a significant reduction in downstream river channel instabilities. The primary role played by vegetation in this situation related to an increase in root cohesion which served to reduce landscape sensitivity to convective rainfall events which were found in both the data and the model to be the primary contributors to high rates of coarse sediment delivery.