



Effect of grade-control structures on longitudinal sediment connectivity: examples from the flysch Carpathians, Czech Republic

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The construction of a staircase-like system of grade-control structures (GCSs) including check dams (at least 1.5–2.0 m heights above the bed level) and bed sills (lower heights), represents a traditional approach for management of mountain streams in the Czech Republic. The sequence of GCSs usually decreases bedload transport rates and thus, affects the connectivity of coarse bed sediments in stream longitudinal direction. The application of Wolman pebble counts demonstrated downstream coarsening of bed sediments within the GCSs sequences in the 1.7 km and 2.6 km long reaches of two relatively steep gravel-bed rivers Tyra ($A \approx 20 \text{ km}^2$; $0.01 > S > 0.03 \text{ m/m}$; $W \approx 10 \text{ m}$; 13 GCSs) and Mohelnice ($A \approx 40 \text{ km}^2$; $0.01 > S > 0.03 \text{ m/m}$; $W = 15 \text{ m}$; 18 GCSs) draining the northern slopes of the Moravskoslezské Beskydy Mts, Western Carpathians. The same situation was observed in the 1.2 km long reach of the steep headwater stream Velka Hanzlůvka ($A \approx 5 \text{ km}^2$; $0.02 < S < 0.06 \text{ m/m}$; $3 < W < 5 \text{ m}$; 5 GCSs). Additionally, photogrammetry together with the measurement of the largest particles deposited in small gravel bars showed independence between the local grain-sizes and calculated bankfull bed shear stresses in the 2.7 km long managed reach of the piedmountain stream Bystry ($A \approx 5 \text{ km}^2$; $0.01 < S < 0.04 \text{ m/m}$; $4 < W < 5 \text{ m}$; 38 GCSs). As the result, we did not observed any downstream fining of these bar deposits although the bed slope significantly decreased by increasing longitudinal distance. Note that all the studied reaches lacked important sediment sources or tributaries, which would lead to downstream grain-size variations or abrupt changes in transport capacity. It implies that the obtained longitudinal trends in grain-sizes most likely pointed to the selective scouring of fine sediments in relation to the effect of ‘hungry water’. This process was supported by the observations of channel incision and loss of fine sediments ($< 20 \text{ mm}$) downstream the investigated sequence of GCSs in Velka Hanzlůvka. Further tracking of marked bed particles as well as the modelling of morphodynamics will provide additional insight into the coarse sediment connectivity in GCS-managed streams.