A flume study of hydraulic resistance in step-pool channels

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Abstract. Variables contributing to flow resistance in step-pool channels were manipulated via a series of flume runs in order to allow measurement of total resistance of and the relative contributions of grain resistance, spill resistance, and debris resistance. The flume was configured to resemble a step-pool channel with an immobile alluvial bed and large woody debris (LWD), and 36 different debris configurations were established by varying LWD density, length, shape, and orientation. These experiments found that spill resistance (from steps) and debris resistance (from LWD) were responsible for the largest components of total resistance, and that grain roughness was a small component of total resistance when steps and/or debris were present. The relative contributions of grain, spill, and debris resistance depended on discharge, with debris resistance dominating at higher discharges, and debris density, with similar contributions from spill and debris components at low debris densities and greater debris roughness at higher debris densities. Resistance was positively correlated with debris density and inversely correlated with discharge. Piece length had minimal effect on resistance for a given debris density, and debris pieces oriented perpendicular to flow created greater resistance than ramped pieces.

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