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Channel morphology and patterns of bedload transport in fluvial, formerly-glaciated, forested headwater streams of the Columbia Mountains, Canada

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This study examines channel-reach morphology and bedload transport dynamics in relation to landscape structure and snowmelt hydrology in Cotton and Elk Creek, two headwater streams of the southern Columbia Mountains, Canada. Data collection is based on field surveys and GIS analysis in conjunction with a nested monitoring network of water discharge and bed load transfer. The nested monitoring network is designed to examine the effects of channel bed texture, and the influence of free-formed (i.e. boulder cascades, step pools, and riffle pools) and forced-alluvial morphologies (i.e. forced step pools) on bedload entrainment and transport.

The landscape is characterized by subdued glaciated topography in which sediment is primarily supplied by bank failures and fluvial transfer dominates the channelized sediment cascade. The spatial distribution of channel types is mainly controlled by glacially imposed local slope together with availability of wood and glacigenic materials. Interestingly, downstream hydraulic geometry as well as downstream patterns of the coarse channel bed fraction and stream power are all insensitive to systematic changes of local slope along the typically stepped longitudinal profiles. An indication that the study alluvial systems are adjusted to the contemporary hydrologic and sedimentary regimes, and as such through post-LGM times have been able to compensate for the glacially-imposed boundary conditions.

Stepwise multiple regression indicates that annual bedload yield is chiefly controlled by the number of peak events over threshold discharge. During such high flows, repeated destabilization of channel bed armouring and re-mobilization of sediment stored behind logjams can ensure sediment supply for bedload transport across the entire snowmelt season. In particular, channel morphology affects distinctively the variability of bed load response to hydrologic forcing. The observed spatial variability in annual bedload yield appears to correlate with inter-basin differences in basic morphometric attributes, among which slope aspect plays a prominent role.