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The impact of benthic fauna on fluvial bed load transport: Challenges of upscaling laboratory experiments to river and landscape scales.

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The impact on sediment transport processes and channel morphology of several relatively large, iconic animals including beaver and salmon is increasingly well understood. However, many other aquatic fauna are important zoogeomorphic agents and ecosystem engineers. These somewhat overlooked "Cinderella" species include benthic aquatic insect larvae, freshwater crustaceans and many species of fish. Despite relatively modest individual effects, the ubiquity, abundance and cumulative impact of these organisms makes them a potentially significant agency, with as yet undiscovered and unquantified impacts on channel morphology and sediment fluxes. Their actions (digging, foraging, moving, burrowing), constructions and secretions modify bed sediment characteristics (grain size distribution, interlock, imbrication, protrusion), alter bed topography (thence hydraulic roughness) and contribute to biogenic restraints on grain movement. In turn, they can affect the distribution of surface particle entrainment thresholds and bed shear stresses, with implications for bed load transport. Flume experiments have measured some of these impacts and provided direct observations of the mechanisms involved, but many of the most interesting research questions pertain to the impact of these animals at reach, catchment and even landscape scales: Not least, what is the impact of small aquatic animals on bed load flux and yield? This presentation will consider some of the challenges involved in answering this question; that is, of scaling up experimental understanding of how aquatic animals affect bed load transport processes to river scales. Pertinent themes include: (1) the potential impacts of experimental arrangements on the behaviours and activities that affect hydraulic or geomorphological processes; (2) field coincidence of the spatial and temporal distributions of (a) the animals and their behaviours with (b) the physical conditions (substrates, flows) under which those animals are understood to have an effect; (3) the magnitude of any demonstrable net field impact, relative to those other factors that control bed load transport rates.