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Experimental assessment of the effects of changing hydraulics on sediment entrainment and invertebrate drift

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Elucidating the relations between channel hydraulics, sediment dynamics and invertebrate behaviour is important both to understand the implications of flood events on benthic community structure and to help the development of environmental flow regimes in regulated rivers. However, elucidation is hampered by the practical difficulties of undertaking field experiments in river channels during high flows. We used a small portable flume to manipulate hydraulic conditions in a reach of the Ribera Salada, a gravel-bed river located in the Southern Pyrenees. Experiments were conducted on isolated patches of fine sediment (median particle sizes 0.6-2.2 mm) distributed across the reach. The effects of increases in shear stress on sediment entrainment and the entry of a number of invertebrate taxa into the water column were assessed. The manipulations created hydraulic conditions typical of those found during the early stages of floods or during small, frequent events. Bedload rates created by the manipulations were low (max 6 g/sm, i.e. marginal transport), with entrained material typically being sand and fine gravel fractions. Transport rates decreased significantly and particle size became finer and more homogeneous within five minutes of the hydraulic manipulations. The entry of animals into the drift was related directly to particle instability and subsequent entrainment from the bed. The response of individual taxa to changing hydraulic conditions and bed instability differed markedly. Some taxa (e.g. Baetis) were always present in the drift whereas others (e.g. Caenis) were only found

in the water column once bedload transport occurred. Heptageniidae, a family whose flattened body shape is often interpreted as an adaptation to living in high velocity locations, showed a clear and rapid response to relatively small increases in shear stress. The differing responses can be interpreted in terms of species' microhabitat preferences. Overall, the experiments indicate that the magnitude and duration of bedload transport during the early stages of floods in gravel-bed rivers is mostly controlled by patches of fine material. In addition, data suggest that even small flood events can result in marked increases in drift and hence short term alterations to benthic community structure.