



The importance of hydrological exchange and sedimentary characteristics on the distribution of macroinvertebrates: insights from laboratory and field experiments

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The distribution of lotic fauna is widely acknowledged to be patchy reflecting the interaction of biotic and abiotic factors. Although there is growing recognition of the role that interstitial flows play in structuring benthic and hyporheic invertebrate communities, the effect of flow dynamics at small spatial scales and the associated sedimentary characteristics upon macroinvertebrates remain poorly quantified. In this paper we reflect on a number of mesocosm and field experiments conducted over 7-years which have sought to understand the processes influencing the distribution of macroinvertebrates at the surface-groundwater interface.

In a series of novel mesocosm experiments we examined the influence of vertical hydrological exchange and pattern of fine sediment loading (benthic and hyporeheic) on the distribution of a freshwater amphipod. We found that faunal movement, and use of benthic and hyporeheic substrata, was strongly influenced by sedimentation and modified by the pattern of vertical hydrological exchange. Further experiments examined how the characteristics of fine sediment (particle size and heterogeneity) and an individual's body size controlled the ability of invertebrates from accessing the hyporeheic zone. Finally through field experiments and surveys, we examined the riffle scale distribution of macroinvertebrates in association with the pattern of fine sediment and hydraulic exchange (upwelling, downwelling and horizontal). Our results highlighted the importance of horizontal interstitial flows as an important pathway for fine sediment transport. Differences in fine sediment accumulation were also observed between riffle heads and tails associated with hydrological exchange with this corresponding to the presence of distinct macroinvertebrate assemblages.

The results of our research demonstrate that spatial differences in fine sediment deposition are evident at the riffle scale as a function of vertical and horizontal subsurface flows and that both these factors in addition to biotic characteristics such as body size, play a key role in the distribution of macroinvertebrate fauna. We highlight the value of conducting research at multiple scales to gain a holistic understanding of the processes controlling ecological functioning at the surface-groundwater interface.