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Do predator-prey relationships on the river bed affect fine sediment ingress?

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Ecosystem engineers are organisms that alter their physical environment and thereby influence the flow of resources through ecosystems. In rivers, several ecosystem engineers are also important geomorphological agents that modify fluvial sediment dynamics. By altering channel morphology and bed material characteristics, such modifications can affect the availability of habitats for other organisms, with implications for ecosystem health and wider community composition. In this way geomorphological and ecological systems are intimately interconnected. This paper focuses on one element of this intricate abiotic-biotic coupling: the interaction between fine sediment ingress into the river bed and the predator-prey relationships of aquatic organisms living on and in the river bed.

Signal crayfish (Pacifastacus leniusculus) have been shown to modify fine sediment fluxes in rivers, but their effect on fine sediment ingress into riverbeds remains unclear. Many macroinvertebrate taxa have adapted avoidance strategies to avoid predation by crayfish, with one example being the freshwater shrimp (Gammarus pulex) which relies on open interstitial spaces within subsurface sediments as a refuge from crayfish predation. Fine sedimentation that fills gravelly frameworks may preclude access to those spaces, therefore leaving freshwater shrimp susceptible to predation.

Ex-situ experiments were conducted which sought to examine: i) if freshwater shrimps and signal crayfish, alone and in combination, influenced fine sediment infiltration rates; and ii) whether modifications to substratum composition, specifically the introduction of fine sediment, modified predator-prey interactions. The results demonstrate that crayfish are significant geomorphic agents and that fine sediment ingress rates were significantly enhanced in their presence compared to control conditions or the presence of only freshwater shrimps. The combination of both organisms (i.e. allowing the interaction between predator and prey) resulted in intermediate fine sediment infiltration rates. The results suggest that reductions in prey availability may enhance crayfish foraging behaviour and therefore their impact on fine sediment ingress into river beds. Consequently, as invading species become more established and prey resources are depleted, the implications of invasive crayfish on fine sediment dynamics may become more prominent. These experiments demonstrate the importance of abiotic-biotic coupling in fluvial systems for both geomorphological and ecological understanding.