



## **Biotic drivers of fluvial sediment transport: Aggregate effects of sediment mobilisation by crayfish on catchment-scale sediment yield**

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Small but prolific organisms may be significant zoogeomorphic agents that make cumulative contributions to the large-scale terrestrial sediment cascade in, as yet, unknown and unquantified ways. One such organism is the signal crayfish (*Pacifastacus leniusculus*), which has invaded many European rivers. The geographical extent and abundance of this animal ensure innumerable local, small-scale interactions with the fluvial sediment system that have the potential to yield a substantial effect when aggregated across larger spatial and temporal scales. Here we estimate, for the first time, the proportion of the total annual sediment yield associated with crayfish activity in an infested river and examine the variability in crayfish-driven sediment flux integrated across daily, monthly and seasonal time scales.

We focused on one of several mechanisms by which crayfish activities affect sediment dynamics: the mobilisation of fine sediments by foraging, fighting and burrowing under hydraulic conditions that are otherwise insufficient to entrain sediment. On the Brampton Branch of the River Nene, UK, a 12-month record of suspended sediment concentration (derived from a calibration of turbidity data against measured SSC) allowed calculation of sediment fluxes and integrated sediment loads at ten-minute intervals. Concurrent measurements of water depth and crayfish movements (using PIT tagging) confirmed that night-time crayfish activity was often associated with increased sediment fluxes in the absence of any change in hydraulic conditions. Sediment loads calculated for these periods of crayfish activity were compared with total loads to estimate the contribution made to sediment mobilisation by crayfish.

Crayfish-induced fluxes were most significant during summer low-flows, becoming less important during winter when the crayfish were inactive and competent high flows dominated sediment transport. Nevertheless, the seasonal cumulative effect of crayfish was substantial and implies that crayfish can be important drivers of sediment movement in infested rivers. Moreover, observations suggest that a large proportion of the sediment available for transport during winter floods is introduced by bank retreat caused by crayfish burrowing. This implies that the total effect of crayfish on sediment yield is substantially greater than estimates based on entrainment effects alone.