

Interactions between fine-grained sediment delivery, river bed deposition and salmonid spawning success

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Abstract Salmonids clean river bed gravels to lay their eggs. However, during the incubation period fine sediment infiltrates the bed. This has been found to limit the success of salmonid spawning, as fine sediment reduces gravel permeability resulting in intra-gravel flow velocities and O₂ concentrations decreasing. The success of salmonid spawning is therefore a function of the coincidence of fine sediment delivery and the development of the salmonid eggs. The presence of fine sediment also exerts sub-lethal effects on the rate of egg development with a negative feedback slowing and extending the incubation process meaning the eggs are in the gravels for longer and susceptible to more potential sediment delivery events. The SIDO (Sediment Intrusion and Dissolved Oxygen)-UK model is a physically-based numerical model which simulates the effect of fine sediment deposition on the abiotic characteristics of the salmonid redd, along with the consequences for egg development and survival. This model is used to investigate the interactions and feedbacks between the timing and concentrations of suspended sediment delivery events, and the deposition of fine sediment within the gravel bed, and the consequences of this on the rate of egg development and survival. The model simulations suggest that egg survival is highly sensitive to suspended sediment concentrations, particularly to changes in the supply rate of sand particles. The magnitude, frequency and specific timing of sediment delivery events effects egg survival rates. The modelling framework is also used to investigate the impact of the rate of gravel infilling by sediment. The hypotheses of continual, discrete event and non-linear decline in the rate of infilling are investigated.

Key words fine sediment; deposition; salmonids; numerical modelling