Improving the knowledge base on the physical effects of fine sediment for macroinvertebrates

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Project outline

Excessive fine sediment delivery to riverine ecosystems can cause serious deleterious effects to aquatic systems and is one of the leading causes for failure to meet Good Ecological Status under the EU Water Framework Directive (2000/60/EC). Ecosystem responses to fine sediment represent a complex mix of direct and indirect effects. Responses may depend on the composition of the fine material delivered to the river network from diverse sources, including from agriculture, industry and urbanisation. There is a wealth of evidence describing community level responses to fine sediment pollution but a distinct absence of studies that consider the direct physical effects of fine sediment at the organism level. Such direct effects are often assumed to affect the soft tissues of aquatic biota through clogging and abrasion. Testing this assumption would aid a greater understanding of the effects of fine sediment and in turn help better define targets for fine sediment loadings and improve upon current biomonitoring tools. We therefore set out to assess the extent of clogging and abrasion on the gills of aquatic macroinvertebrates through a novel combination of high-powered microscopy and image analysis.

Methodology

Cadavers of *Ephemera danica* (Ephemeroptera: Ephemera), *Ecdyonurus venosus* (Ephemeroptera: Heptageniidae) and *Hydropsyche siltalai* (Trichoptera: Hydropscyhidae), were exposed for six hours in a recirculating flume to three concentrations of fine sediment control (<2.5 NTU), low (100 NTU) and high (400 NTU) and two velocities low (0.19 m s^{-1}) and fast (0.38 m s^{-1}). After exposure, the cadavers were removed, gills were prepared for microscopy and images taken using Scanning Electron Microscopy which was made possible through funding awarded through the Postgraduate Research Fund by the British Society for Geomorphology. Images were converted for quantitative analysis using a recently described non-automated digital image analysis method (Turley et al., 2017).

Preliminary results

Physical effects presented predominantly in the form of clogging and build-up of debris on gill structures. Gills from cadavers of different species were damaged to varying extents and responded differently to treatments in a way that suggested gill morphology and behavioural responses (such as avoidance) as key factors.

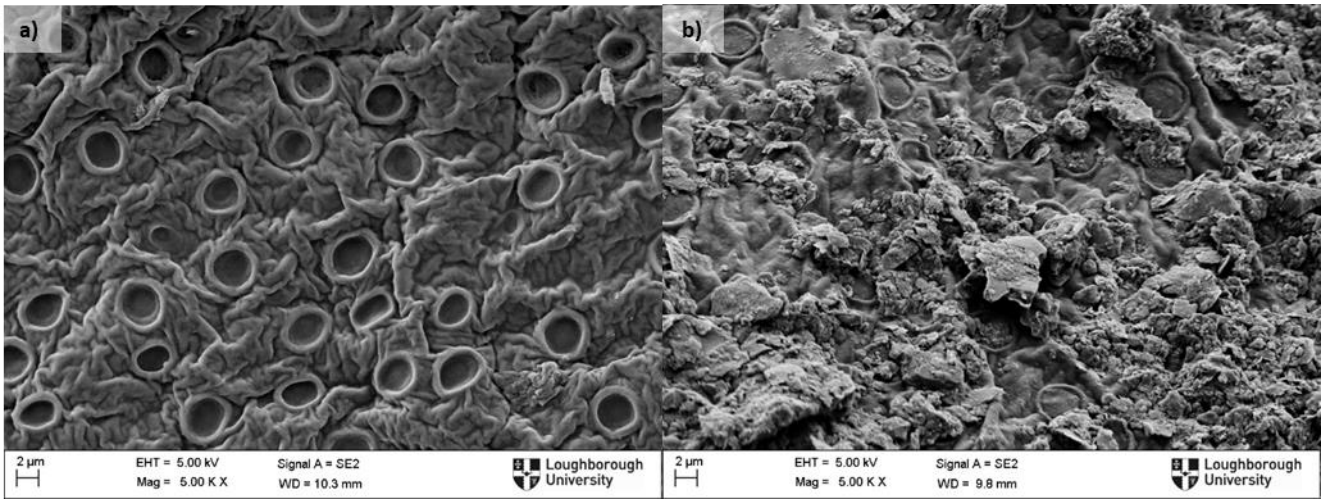

Figure 1. Preliminary results of SEM images of *Ecdyonurus venosus* (Ephemeroptera: Heptageniidae) (a) without exposure and (b) after exposure to fine sediment in a recirculating flume.

Summary

Exposing insect cadavers to fine sediment in a recirculating flume experiment resulted in physical effects in the form of clogging and build-up of debris, revealed using scanning electron microscopy.

References. Turley, M. D., et al. (2017). Quantifying submerged deposited fine sediments in rivers and streams using digital image analysis. *River Research and Applications*, *33*(10), 1585-1595.