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Evaluating the provenance of fine sediment in degraded Freshwater Pearl Mussel habitats.

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Freshwater Pearl Mussels (FWPM), *Margaritifera margaritifera*, are among the most critically threatened freshwater bivalves worldwide. In addition to their important roles in particle processing, nutrient release, and sediment mixing, they also serve as an ideal target species for evaluation of aquatic ecosystem functioning especially in the context of their symbiotic relationship with Atlantic salmon *Salmo salar* and brown or sea trout *Salmo trutta*. Poor water quality, particularly eutrophication, and siltation are considered major contributory factors in the decline of the species hence management of diffuse water pollution from agriculture (DWPA) is a key priority in catchments that host FWPM habitats. Against this background, this study adopted a combined monitoring, surveying and sediment fingerprinting approach to determine the principal sources of fine sediment impacting FWPM habitats in the River Clun, a Special area of Conservation (SAC) for FWPMs in central western UK.

Potential sediment production hotspot areas in the ca 200 km^2 catchment area upstream of FWPM habitats were initially evaluated using the SCIMAP risk mapping tool. Suspended sediment monitoring was undertaken on the main stem channel where FWPM habitats are located and wet weather catchment walkover surveys undertaken along the upstream river and stream network. Within this monitoring framework, sediment fingerprinting was undertaken at two levels. The first level aimed to link primary catchment sources (cultivated and uncultivated soil, channel bank erosion, and material transported via roads and tracks) to suspended sediment output from each main tributary upstream of the FWPM beds. The second level linked silt in the FWMP beds to the main tributaries, as integrated source end-members, with the inclusion of main channel bank erosion, a notable feature of walkover surveys as an additional source.

Geochemical fingerprints, determined by XRF spectroscopy, were dominated by conservative mineral-bound elements and results indicated the importance of mainstem channel bank erosion as a sediment source to the FWMP beds, in line with catchment walkover observations. In addition, broad subcatchment discrimination and subsequent sediment apportionment showed agreement with SCIMAP risk analysis for more intensively farmed areas. Fingerprinting results also suggested, however, an unexpected contribution from upland grazed areas, categorised as lower risk by SCIMAP. Detailed evaluation of primary sources in these areas was undertaken to evaluate this discrepancy and test the hypothesised importance of channel bank erosion at the subcatchment scale. The results highlight the benefits of adopting a combined monitoring, modelling and tracing approach to support targeted management of fine sediment problems.

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