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Evaluating an ecosystem management approach for improving water quality in two contrasting study catchments in south-west England.

Miriam Glendell and Richard Brazier

University of Exeter, Geography - College of Life and Environmental Sciences, Exeter, United Kingdom (mg418@exeter.ac.uk)

The European Water Framework Directive (WFD) 2000 established a new emphasis for the management of freshwaters by establishing ecologically-based water quality targets that are to be achieved through holistic, catchment-scale, ecosystem management approaches. However, significant knowledge gaps still exist in the understanding of the cumulative effectiveness of multiple mitigation measures on a number of pollutants at a catchment scale. This research furthers the understanding of the effectiveness of an ecosystem management approach to deliver catchment-scale water quality improvements in two contrasting study catchments in south-west England: the lowland agricultural Aller and the upland semi-natural Horner Water.

Characterisation of the spatial variability of soil properties (bulk density, total carbon, nitrogen, C:N ratio, stable isotope δ^{15}N, total, organic and inorganic phosphorus) in the two study catchments demonstrated extensive alteration of soil properties in the agricultural catchment, with likely long-term implications for the restoration of ecosystem functioning and water quality management (Glendell et al., 2014b).

Further, the agricultural catchment supported a proportionally greater total fluvial carbon (dissolved and particulate) export than the semi-natural catchment. During an eight month period for which a comparable continuous turbidity record was available, the estimated SS yields from the agricultural catchment (25.5-116.2 t km^{-2}) were higher than from the semi-natural catchment (21.7-57.8 t km^{-2}). In addition, the agricultural catchment exported proportionally more TPC (0.51-2.59 kg mm^{-1}) than the semi-natural catchment (0.36-0.97 kg mm^{-1}) and a similar amount of DOC (0.26-0.52 kg mm^{-1} in the Aller and 0.24-0.32 kg mm^{-1} in Horner Water), when normalised by catchment area and total discharge, despite the lower total soil carbon pool, thus indicating an enhanced fluvial loss of sediment and carbon (Glendell and Brazier, in review).

Whilst detection of catchment-scale effects of mitigation measures typically requires high resolution, resource-intensive, long term data sets, we found that simple approaches can be effective in bridging the gap between fine-scale ecosystem functioning and catchment-scale processes. Here, the new macro-invertebrate bio-monitoring index PSI (Proportion of Sediment-sensitive Invertebrates) has been shown to be more closely related to a physical measure of sedimentation (% fine bed sediment cover) (P = 0.002) than existing non-pressure specific macro-invertebrate metrics such as the Lotic Index for Flow Evaluation (LIFE) and % Ephemeroptera, Plecoptera & Trichoptera abundance (% EPT abundance) (P = 0.014)(Glendell et al., 2014a). Thus PSI and % fine bed sediment cover have the potential to become a sensitive tool for the setting and monitoring of twin sedimentation targets to inform the delivery of WFD objectives.

Finally, whilst upland ditch management has not had any discernible effect on water quality in the semi-natural upland catchment one year after restoration, future monitoring will evaluate the effectiveness of the recent and soon to be implemented land management changes on delivering water quality improvements in the lowland agricultural catchment.

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