Geophysical Research Abstracts
Vol. 16, EGU2014-716, 2014
EGU General Assembly 2014


# Developing a biomonitoring tool for fine sediment

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Sediment is an essential component of freshwater ecosystems; however anthropogenic activities can lead to elevated sediment delivery which can impact on the physical, chemical and biological characteristics of these ecosystems. Ultimately, this can result in a loss of ecosystem services worth more than $1.7 trillion per annum. As such it is important that sediment, which is one of the most commonly attributed causes of water quality impairment globally, is managed in order to minimise these impacts.

The current EU environmental quality standard for sediment (monitored in the form of suspended solids) is 25 mg $L^{-1}$ for all environments. It is widely recognised that this standard is unsuitable and not ecologically relevant. Furthermore, it requires a substantial resource investment to monitor sediment in this form as part of national and international water resource legislation. In recognition of this the development of sediment-specific biomonitoring tools is receiving increasing attention. The Proportion of Sediment-Sensitive Invertebrates (PSI) index is one such tool that is designed to indicate levels of fine sediment (<2mm in size) deposition in streams. Despite having a sound biological basis, until now, the PSI index has only been tested against observed sediment data in two catchments in the UK; other published applications of the PSI index have relied on inferred sediment values when applying the index.

In this paper, we report the results of a comprehensive analysis of the performance of the PSI index, through examining the relationships between PSI scores and observed sediment data (suspended and deposited sediments), collected from 835 reference condition temperate stream/river ecosystems. The results of this study show the PSI index is more strongly correlated with sediment metrics than any of the other biological indices tested, including Biological Monitoring Working Party (BMWP), Number of Taxa (N-Taxa), Average Score Per Taxon (ASPT), and Lotic Invertebrates for Flow Evaluation (LIFE). The strongest Spearman's rank correlation between PSI and any of the observed sediment data, was with the percentage of the substratum comprised of sand, silt and clay ($r_s$ = - 0.653, $p$ <0.01). To put this into context, a study of 80 invertebrate-based indices that are used for the implementation of the WFD across Europe, found the median correlation coefficient to be 0.64 in relation to their respective stressor. Nevertheless, given the implications of incorrect assignment of ecological status of streams for both water and land managers, more efforts are needed to calibrate and improve the performance of biological indices to achieve robust models. We propose an approach to enhance the performance of the model for future applications using a more objective quantitative method of measuring deposited sediments.