THE APPLICATION OF SEDIMENT SOURCE FINGERPRINTING TECHNIQUES TO RIVER FLOODPLAIN CORES, TO EXAMINE RECENT CHANGES IN SEDIMENT SOURCES IN SELECTED UK RIVER BASINS

Submitted by
Stephen Haley
To the University of Exeter as a thesis for the degree of
Doctor of Philosophy in Geography

Stephen M. Haley
(November, 2010)

ABSTRACT

In recent years there has been an increasing awareness of the detrimental influence of diffuse sources of pollution on aquatic systems and of the integral role played by sediment in the mobilisation and transport of pollutants. The recognition of the environmental, societal and economic importance of the ecological health of aquatic environments has led to a change in emphasis regarding agricultural and environmental policy. To implement successful delivery of emerging policy requirements, there is a current need to have an enhanced understanding of the relationship between different forms of land use and sources of diffuse pollution, particularly sources of fine sediment. To understand the potential impacts of future land use changes, including environmental conservation measures on sources of sediment, it is useful to consider them within a longer-term context. This study has successfully applied the sediment source fingerprinting technique to floodplain overbank sediment cores in a retrospective study of six diverse UK river catchments with identified sediment problems. The varying estimates of relative sediment contributions from differing sources have been compared to known land use change in the study catchments over concurrent time periods, to explore any associations which might be apparent. Over the last 40 years, the increased cultivation of high erosion risk crops, such as those which are harvested late in the season (e.g. maize) and those which are sown in the autumn (e.g. winter wheat), has contributed disproportionately to the total sediment load relative to the area of land occupied by such cultivation. Increased stocking densities have resulted in increased relative sediment contributions from grassland sources, particularly intensively managed temporary grassland, but can have an even greater impact on sediment contributions derived from channel bank sources. The installation and maintenance of drainage for agriculture or for flood risk management has resulted in increased relative sediment loads from channel bank and associated sub-surface sources. Through the further development of such research, the efficacy of mitigation measures can be tested against evidence-based historic trends and those management approaches which provide identifiable improvements can be developed as best practice options for future land management targeted at reducing the negative impacts of excessive sediment ingress to river systems. The design of the source fingerprinting methodology used in this work was based on an established successful approach and this was developed further through the incorporation of a number of refinements designed to improve the robustness of the technique and expedite its implementation.

TABLE OF CONTENTS

CONTENTS