science summary

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Incorporating climate change in river typologies for the Water Framework Directive

Science Summary SC030301/SS

Researchers at Newcastle and Lancaster Universities have reviewed a number of different approaches for including climate change in existing geomorphological, hydrological and ecological typologies of rivers. This review offers new understanding about links between these three elements, necessary for implementing the EU Water Framework Directive (WFD). The report covers the application of the most promising of these approaches to a case study on the River Eden, along with assessing potential changes in habitat availability under different climate change scenarios.

The WFD does not explicitly consider the implications of climate change. However there is the potential to do so by carefully defining 'ecological status' and via the adaptive management elements of the Directive. Ecological status is assessed at River Basin District scales, within which individual water bodies are characterised. Water bodies are currently described using 'top-down' typologies, which are large-scale and simple. There is a need to incorporate better process information, which explains why a river type is present rather than simply describing its appearance, if climate change impacts are to be covered under the WFD.

More detailed process information would help to characterise water bodies and define ecological status more accurately. Incorporating driving variables and ecosystem resilience might also help to identify potential programmes of measures (POMs) that include adaptation to climate change Geomorphology, hydrology and ecology should ideally be combined in a spatial context to ensure that both up and downstream interactions at the catchment scale are considered.

None of the reviewed approaches are directly transferable to rivers in England and Wales and their integration of geomorphology, hydrology and ecology is generally poor. A minority of the typologies are process-based but have not been widely applied to real scenarios or rivers, and would need to be modified for use in England and Wales. However, some variables from existing typologies (such as slope, stream power and flow characteristics) can be used to create datasets suitable for climate change assessment.

A significant research gap, widely identified as a potential flaw in the delivery of the WFD, is in the workable concept of 'hydromorphology' and its impact on long-term ecosystem functioning. The current assumption is that diverse channel and flow conditions boost biodiversity. The authors recommends a catchment scale test using process-based geomorphological typologies, within which local variability in channel morphology and flow variability can be compared with biological and ecological habitat and species population data. This will establish links between hydromorphological (geomorphology and hydrology) and ecological status as required by the Directive. Hydraulic modelling can then be used to explore changes in available aquatic habitat and scaled up to assess catchment implications for habitat loss or gain and impacts on ecological status from different climate scenarios.

The final part of this project explores the results of a study of an example catchment. The Eden in Cumbria was chosen for its physiographic variability and biodiversity importance and was used to collect data necessary to explore complex interactions over a range of spatial and temporal scales. The proposed approach involves developing tools to describe geomorphological structure at the catchment, basin, reach, and bedform scale, with ecologically relevant definitions of fluvial habitats. The field study in this report demonstrates how to produce an 'ecological status map' and explores the potential impact of climate change on both status and interactions between hydromorphology and biological quality.

This report will help users who are implementing the WFD to consider the potential impacts of climate change. The report explains how to carry out catchment-scale tests and develop measures to adapt to climate change The results of this study provide

useful data for a river basin management plan, including a programme of measures (POM), for the Eden along with approaches that could be applied elsewhere.

This summary relates to information from Science Project SC030301, reported in detail in the following output(s):-

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