HS10.7/GM9.9

Linking river ecology, hydrology, and geomorphology for integrated river management (co-organized)

Convener: Megan Klaar
Co-Conveners: Paolo Perona, Josie Geris, Matthew Johnson

Abstract submission Convener Login

River ecosystems are characterised by a highly interactive, complex and often delicate balance between ecological, hydro-morphological, hydrochemical and thermal regimes. While the conditions or states of these systems are greatly variable in both space and time, they are also increasingly subjected to anthropogenic (e.g. river abstractions, impoundments, releases and other regulation) and climatic pressures. Particular challenges to the development of ecologically appropriate river management that require inter-disciplinary approaches include defining the natural state or 'reference conditions', the identification of system change or resilience to impacts of anthropogenic and climatic stressors, and the management actions required to maintain good status or enable recovery.

The aim of this session is to evaluate the current research knowledge on the inter-linkages of in-stream ecology, hydrology, morphology, and other environmental and anthropogenic (change) factors, how these affect ecosystem functioning at a range of spatio- and temporal scales, and how this information can be used to inform sustainable river ecosystem management. Multidisciplinary contributions are invited from field-based and/or modelling studies that provide new insights into these various linkages across scales. Contributions on innovative measurement, analyses and modelling approaches are also particularly encouraged, as are case studies and papers that consider a range of spatial and temporal scales. Specific topics of interest could include, but are not limited to: identifying environmental controls of river ecology; hydraulic and geomorphic interactions with aquatic communities, including ecosystem engineering; biogeochemical and thermal dynamics of rivers; impacts of river regulation and climate change on river ecosystems; dynamic environmental flows; sustainability of ecologically appropriate river restoration and management; and how scientific evidence can inform policy.

The session features an invited talk by Prof Stephen Rice (Loughborough University, with co-authors Andrew Pledger, James Smith and Julia Toone) entitled “Who’s been feeding in my bed? Benthivorous fish and fluvial sediment transport – fact or fairy tale?"

Abstract:

Assessing Impacts of Hydropower Regulation on Salmonid Habitat Connectivity to Guide River Restoration

Anthropogenic activity in riverine ecosystems has led to a substantial divergence from the natural state of many rivers globally. Many of Scotland’s rivers have been regulated for hydropower with increasing intensity since the 1890s. At the same time they sustain substantial populations of Atlantic Salmon (*Salmo salar* L.), which have a range of requirements in terms of flow and access to habitat, depending on the different life-stages. River barriers for hydropower regulation can change the spatial

and temporal connectivity within river networks, the impacts of which on salmon habitat are not fully understood. Insight into such changes in connectivity, and the link with the distribution and accessibility of suitable habitat and areas of high productivity, are essential to aid restoration and/or conservation efforts. This is because they indicate where such efforts might have a higher chance of being successful in terms of providing suitable habitat and increasing river productivity.
In this study we applied a graph theory approach to assess historic (natural) and contemporary (regulated) in-stream habitat connectivity of the River Lyon, an important UK salmon river that is moderately regulated for hydropower. Historic maps and GIS techniques were used to construct the two contrasting river networks (i.e., natural vs. regulated). Subsequently, connectivity metrics were used to assess the impacts of hydropower infrastructure on upstream and downstream migration possibilities for adults and juveniles, respectively. A national juvenile salmon production model was used to weight the importance of reaches for juvenile salmon production.
Results indicate that the impact of barriers in the Lyon on the connectivity indices depends on the type of barrier and its location within the network, but is generally low for both adults and juveniles, and that compared to the historic river network the reduction in the amount of suitable habitat and juvenile production is most marked in the upper reaches of the river.
This study represents an improved approach over more commonly applied assessments that focus on the impact of impoundment on wetted area or river length. Simpler approaches often lack ecological and hydrological detail leading to over- or underestimation of the impacts of river regulation on connectivity depending on the relative quality of available habitat.
Our work aims to integrate hydrological and ecological aspects into a spatially explicit connectivity framework. Such an approach can help to better identify those areas most important to the conservation of fish habitat, inform sustainable management of hydropower schemes, and aid cost-efficient river restoration and management efforts.