Understanding the Relationship Between Flow and Ecological Response to Inform Environmental Flows

Stream

The Industrial Doctorate Centre for the Water Sector

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Introduction

Reservoir releases alter a river's natural flow regime. Legislation has driven the restoration of natural waterbodies to a better chemical and ecological Status (or "Potential" for heavily modified sites). As ecology is a key indicator of the overall Status/Potential of a waterbody, the impact of modified flows upon ecological health has became a key subject of study (see Figure 1 for details).

The relationship between flow regime and ecology is complex and not comprehensively understood. A better understanding of this relationship is needed if we are to be able to make general prescriptions for reservoir outflows to ensure good ecological function in managed watercourses.

Pictured: A natural river reach contrasted with a highly engineered river just downstream of a reservoir outlet

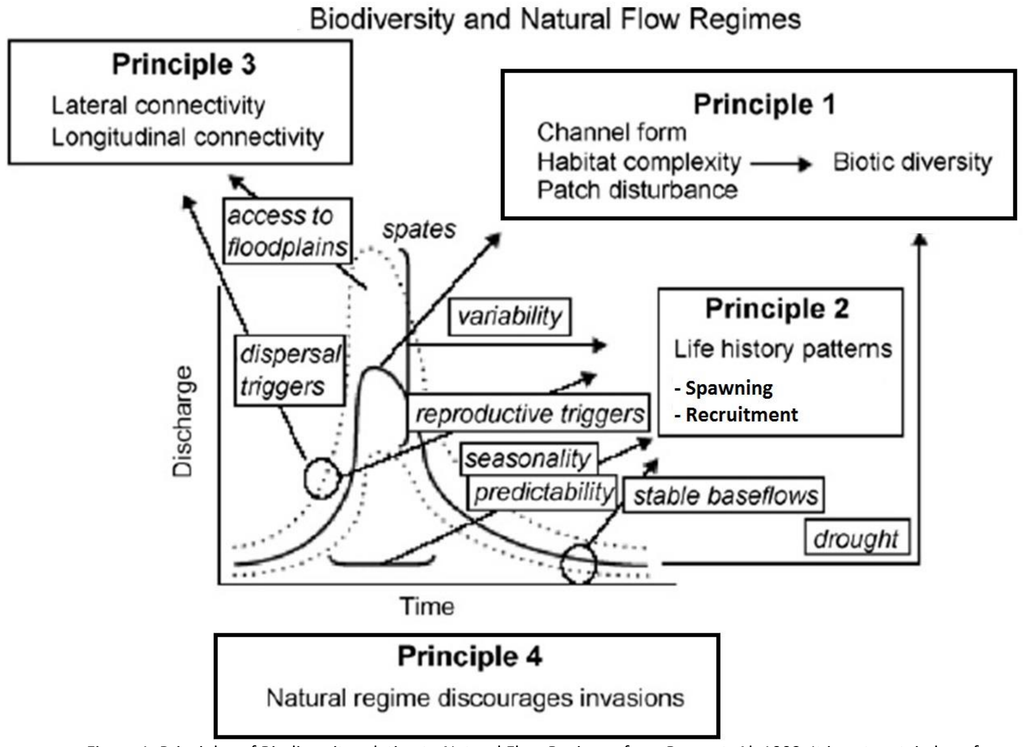

Figure 1: Principles of Biodiversity relating to Natural Flow Regimes, from Bunn et. Al. 1992. It is not certain how far a river system can deviate from natural flow, and in what ways, before there is a significant ecological impact.

Aims

- To analyse the relationship between flow and ecology through a large scale analysis of flow, habitat and invertebrate data for sites across the North West of England, identifying general patterns using Indicators of Hydrological Alteration (Richter et. al . 1996)

- Through the use of hydraulic and ecological modelling, simulate a study site and native ecological response in order to prescribe the most economic and ecologically suitable flow regime for the area.

- Examine how these findings may be used to provide industrial sponsor with practical guidance on meeting Good Ecological Potential for heavily modified water bodies within their remit.

Methods

Ecological Monitoring Data Analysis:

Flow data was characterised at 15 sites using Richter et al (1998)'s Indicators of Hydrological Alteration (see Figure 3 for details). Macroinvertebrate sample data, and environmental/habitat data were also obtained from the Environment Agency for monitoring sites across North West of England. These data are being analysed to identify the ways in which the habitat and hydrological characteristics combine to determine macroinvertebrate response to flow regime, with particular focus on the effects on macroinvertebrates used to assess ecological quality.

Site Modelling:

The River Ogden was chosen as a site for focused investigation. Bed elevations were taken using a Total Station. From this a hydraulic model will be developed which will then feed into the ecological model, CASiMiR. Near-bed forces will be predicted using the hydrological outputs of depth and velocity. These values will then be converted into a habitat suitability map, using the process described below. Habitat maps will be generated for each flow regime inputted into the model, providing insight as to which regime will provide the greatest benefit while also accounting for volume of water used.

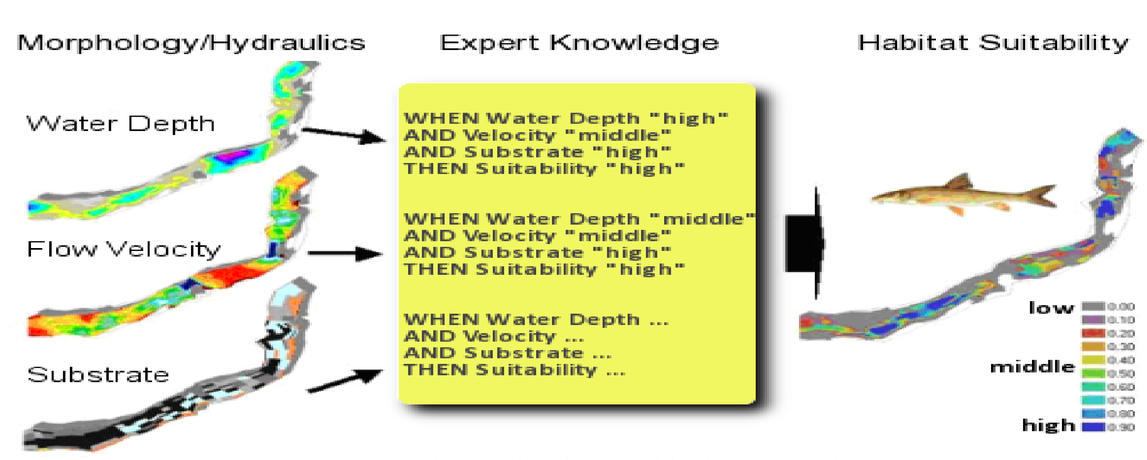

Figure 2: The concept behind CASiMiR; how Habitat Suitability is calculated

Results Synthesis:

Results will be considered in relation to legislative targets in order to generate practical solutions towards the problem of prescribing economically feasible environmental flows without need of highly laborious site specific investigation.

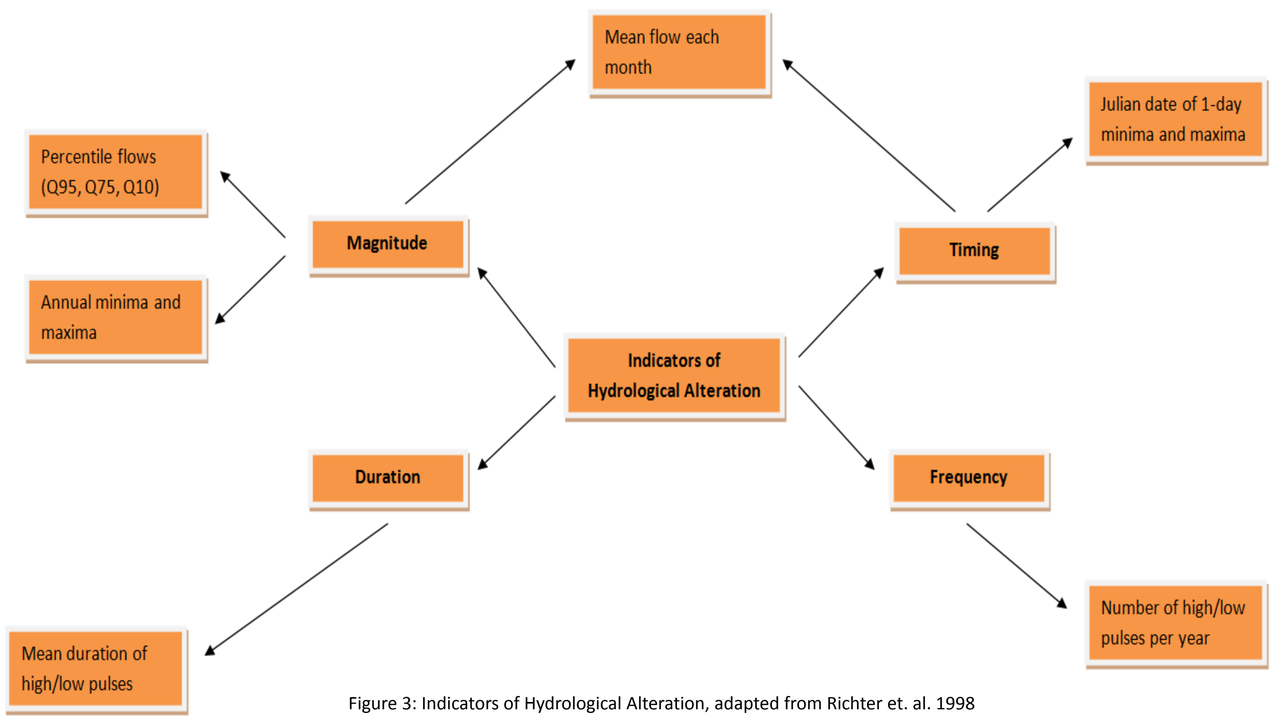

Figure 3: Indicators of Hydrological Alteration, adapted from Richter et. al. 1998

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