Fuzzy cognitive mapping for predicting hydromorphological responses to multiple pressures in rivers (Lorenz et al. 2015) [1]

Different pressures often co-occur in rivers and act simultaneously on important processes and variables. This complicates the diagnosis of hydromorphological alterations and hampers the design of effective restoration measures. Here, we present a conceptual meta-analysis that aims at identifying the most relevant hydromorphological processes and variables controlling ecological degradation and restoration. For that purpose, we used fuzzy cognitive mapping based on conceptual schemes that were created according to 675 scientific peer-reviewed river hydromorphology studies.

A model generated from this approach predicts responses that are consistent with common understanding of the direct interactions between hydromorphological pressures, processes and variables. However, it also leads to new knowledge beyond traditional hydromorphological models by dealing with the complex interactions of hydromorphology, vegetation, water chemistry and thermal regime. Water flow dynamics appeared as the most important of all hydromorphological processes affected by simultaneously interacting pressures. Relevant processes such as vegetation encroachment and sediment entrainment are closely linked to water flow.

Synthesis and applications. Our results demonstrate the relevance of natural flow regime rehabilitation for river management. Hence, we suggest focusing primarily on rehabilitating the natural flow regime before carrying out extensive habitat restoration works. This challenging target in river rehabilitation could strongly increase the success of additional habitat restoration.

Keywords: flow alteration; fuzzy cognitive mapping; habitat alteration; natural flow regime; river management; river rehabilitation; river restoration

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