

HOLISTIC PERSPECTIVES TO RESTORE MODIFIED RIVER FLOWS – A SCIENTIFIC AND PRACTICAL ASSESSMENT

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Abstract

Free-flowing rivers support diverse, complex and dynamic ecosystems. Besides, they provide basic societal and economic services. Globally, however, such ecosystems are becoming scarce. In this regard, hydrological pressures belong to the most dominant stressor group in riverine ecosystems – both in Europe as well as worldwide. Storage dams, water diversions or abstraction schemes and groundwater pumping are among the sources that most directly alter natural flow regimes. Subsequently, these hydrological changes affect crucial ecosystem functions and processes, such as an organism's capacity to fulfil its life cycle requirements, thereby reducing biodiversity and diminishing services that rivers support. In light of these widespread effects, it is urgent to mitigate ecological impacts caused by water infrastructure development. To achieve environmental objectives, as well as to manage water uses in a sustainable way, a thorough understanding of ecological responses to hydrological alterations on different temporal levels (e.g., environmental flow, hydropeaking) is essential. This work, therefore, aims to establish holistic approaches for restoring flows in modified rivers and to develop environmental flows able to deal with the ecological effects of short-term and annual flow modifications in fluvial ecosystems. By incorporating all aspects of the natural flow regime and by considering riverine functions and processes which the regime maintains, this study assists to transfer scientific knowledge of flow-ecology relationships to the successful implementation of flow restoration measures in rivers affected by water abstraction and hydropeaking. Regarding the latter, we identified critical life cycle stages of fish and connected them to flow boundaries which should be capable of preventing deterioration of the river status. Furthermore, we analyzed the environmental flow assessment processes in India and compared it to the EU Water Framework Directive approach. This allowed us to assess how flow restoration schemes proposed by the scientific community can be transferred to and adapted for countries which have only started dealing with the topic a short time ago. Summarizing, this study advances the establishment of guidelines for successful flow restoration in river systems affected by competing water uses by (1) establishing holistic flow restoration schemes, (2) subsuming quantitative and qualitative hydropeaking thresholds, and (3) assessing how restoration knowledge can be blended in different contexts. Thereby, this work contributes to a more balanced discussion on trade-offs between societal and environmental water uses.

Keywords

Environmental flow, hydropeaking, flow-ecology relationships, flow restoration, water management