

Restoration of fluvial dynamics in large rivers: from benchmarking to scenario design

Summary

For most large rivers, converted throughout the past centuries into straightened and impounded channels, the returning to a pre-disturbance state appears unrealistic and potential sustainable restoration targets must balance partial rehabilitation of riverine dynamics with the limitations posed by current human uses. Within the context of large European river-floodplain systems, this thesis presents a methodology for the identification of benchmarks and current biogeomorphic deficits, as the basis for the proposal of process-oriented restoration targets. On the one hand, the free-flowing Upper Rhine River downstream from Iffezheim dam (border France-Germany) and the Middle Ebro River downstream from Castejón (Spain) are good examples of the situation of many large rivers, whose floodplains still keep a proportion of high natural biodiversity but where natural rejuvenating processes are almost non-existent and succession dominates.

On the other hand, the Lower Allier River upstream from Moulins (France) stands as one of the few remaining low impacted and highly dynamic river-floodplain systems in Europe. A comparative diachronic analysis has been made between a near-natural river system in present time (the Lower Allier River) and historical benchmarks for large rivers with different types of alterations (the Upper Rhine River and the Middle Ebro River). Results indicate similarities between them, with balances of progression and regression processes in the benchmark periods, and deficits such as loss of rejuvenation processes whose recovery must be the objective of restoration. Process-based restoration scenarios have been created for the studied degraded river segments, including measures such as rip-rap removal and side channel widening, with the aim of improving hydrological connectivity and regaining regression dynamics, while maintaining navigability. Outcomes from 2-D hydraulic scenario simulations for the Upper Rhine and the Middle Ebro indicate changes in water depth, velocity and shear stress in crucial areas where self-forming biogeomorphic processes (erosion/sedimentation, vegetation renewal) would initiate. The development and analysis of restoration scenarios can help in depicting potential results and involving public and decision makers alike in selecting the most effective restoration target. A sustainable view on river management and restoration should aim at more resilient riverine systems, capable of balancing societal needs and natural processes, especially in the context of climate change adaptation.

Keywords

Process-based river restoration, fluvial processes, biogeomorphology, benchmarks, 2-D hydrodynamic modelling, restoration target, scenarios; large rivers.

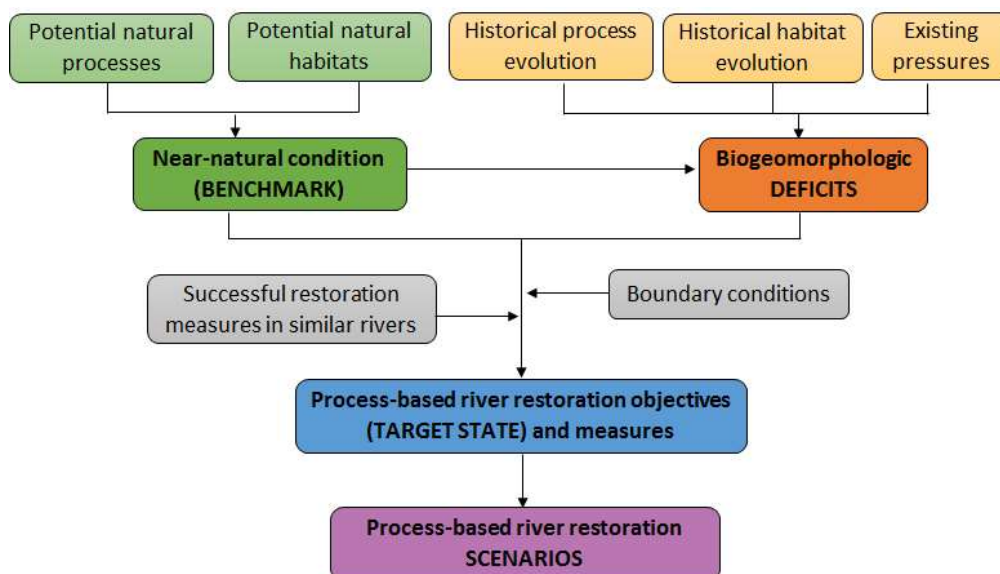


Diagram with the research methodology.



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