

Ecology of Large Rivers, Anthropogenic Pressures and Impacts

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Large river systems (LRS) are much more than just longitudinal channel networks. Especially in low-gradient down stream reaches the natural river channels together with their wide alluvial river-floodplain systems clearly have to be addressed as ecological unities. To understand the high complexity of LRS, their relations and exchange processes with the adjoining ecosystems (tributaries, groundwater, alluvial floodplain forests, etc) requires comprehensive observations at the catchment and/or landscape scale. Modern concepts dealing with river ecology in a holistic way address LRS as multidimensional ecosystems. Natural disturbances (floods, droughts) are key elements that constitute the basis for the highly dynamic nature of riverine landscapes. The complex driving forces and exchange processes acting across three spatial dimensions result in frequently changing connectivity conditions and an especially heterogeneous habitat complex. As the most important consequence of the ever shifting mosaic of habitats and ecotones, natural riverine environments generally feature an outstanding high biodiversity.

Human activities and uses affect LRS in various ways. From an ecological point of view pressures like pollution, river straightening for flood control and/or navigation purposes, and especially hydroelectric power plants create serious problems and impacts on the ecological status. Of crucial importance are pressures, which impact the original hydro-morphological situation (e.g. hydro-peaking, reservoir flushing, cross catchment water diversion, bed-load retention) and/or the natural composition of ecological communities (e.g. through longitudinal migration barriers for migratory fish species). In many countries particularly river bed degradation is a major threat that mostly leads to severe ecological impairment. Locally increased bed load transport and consequently downstream output of bed material caused by channel construction for the improvement of navigation and/or flood control is in many cases additionally intensified by a substantial reduction of the bed load input from the upper catchment (e.g. due to retention by torrent control measures and/or chains of power plants). Since lateral erosion of originally braiding or meandering rivers is limited by channel stabilisation, these processes can not furthermore balance out the natural aggradation of the alluvial floodplains. As a consequence, channel degradation leads to a vertical separation of the river as well as of the floodplain levels and results in hydrological decoupling of the main channel from the alluvial floodplain habitats.

The above examples clearly show that conservation, protection and sustainable development of ecologically intact river-floodplain systems - as required by the EU-WFD - urgently need a new planning philosophy. Instead of one-sided measures and uses, multi-usable riverine landscapes must be the goal to achieve WFD requirements. Catchment wide thinking and cross border cooperation are future challenges calling for multi-disciplinary planning and decision processes. The so called "Leitbild" (target view) that uses natural reference conditions as an environmental orientation objective takes an important role in that approach. However, there are still distinct deficits regarding our knowledge of natural processes in LRS as well as of cumulative effects of various pressures and of methodological standards for their adequate evaluation. Therefore, the need and support of further research is essential and should be emphasised.