

Integrating riparian wetland and river restoration in Europe

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Riparian land is often the most fertile and **productive** part of the landscape, in terms of both agricultural production and natural ecosystems. Besides being so productive, it is often a **vulnerable** part of the landscape between cultivation or over-grazing and natural events such as floods. The combination of productivity and vulnerability means that careful management-restoration of riparian lands is vital for the conservation of unique biodiversity, as well as for sustainable agricultural productivity. Moreover, riparian wetlands, being an interface between catchment and surface water, can play an important role in the control of water quality.

As a consequence, lateral hydraulic connectivity between wetlands, fringe habitats and riparian land with adjacent river channel, from one side, and catchment area from the other, is extremely important to maintain the numerous riparian wetlands functions. The preservation of water quality by buffering diffuse pollution, flood reduction by natural retention areas, habitat improvement for many aquatic organisms, contribute to the reduction of global warming and to the aesthetic value of the landscape are some of the main riparian wetland functions.

The hydraulic connection varies depending on its location within the channel network and on climatic conditions. In headwater streams, water with sediment and solutes flows mainly from catchment areas to the rivers through riparian buffer strips. In contrast, wide, lowland floodplains tend to be isolated from the surrounding terrestrial systems. The floodplains receive significant inputs from the channel and become important source areas, especially during flood recession and periods of low flow. Any restoration project, whether located in the channel, riparian area, or floodplain, is designed to restore a flowing river and its hydraulic connections and must at some point consider the dynamic river as a whole. River dynamics can be used as the central focus of restoration; once restored, a dynamic river can sustain the ecosystem development and maintain its recovered integrity.

Ecological restoration of rivers and riparian wetlands is a challenging topic and has become an important issue for water authorities and river managers in Europe as an effective tool to implement not only WFD (Water Framework Directive 2000/60) but also other strictly linked previous directives such as: Nitrates, Habitat and Birds, and the new-born directives: Bathing water, Groundwater, Flood risk and Marine strategy. Conceptual management framework incorporating objectives for water quality, flood protection and nature conservation can be essential to carry out wetland restoration. The functional role of wetlands within water bodies or river basins is particularly relevant not only for the implementation of the freshwater status according to the WFD objectives but also applies to the relations with and through the groundwater domain.

European rivers and riparian wetlands still suffer from a wide variety of pressures due to: 25% chemical, 32% morphology, 36% hydrology, 13% human use. For example, over 80% of the Danube river basin wetlands and floodplains have been destroyed in the 20th century. Trying to mitigate these impacts, the most common approaches in the European restoration plans are the enhancement of lateral connectivity, habitat creation, bank naturalization, and control of extensive grazing in

the floodplain. Reconnecting floodplains to the channel by removing or lowering the dikes and/or open lateral channels is a measure which is more and more popular along large European rivers to prevent downstream flooding by storing water. In many cases, old river branches have been reopened, either by restoring the in- and out-flow or by digging filled channel courses, or reactivating cut-off meanders. Huge projects that include opening of major embankments to restore functional floodplain areas have been completed in the Romanian Danube Delta and along the River Elbe (Germany).

One of the overall goals of EU agricultural policy is to reduce the ecological impacts of agricultural land-use (loss of habitats, runoff of nutrients, pesticides). For this reason, large areas are set aside from intensive culture. Many of such areas are part of, or connected to, important wetlands. In those cases, transition from extensive agriculture to less impacted land-use may be included in wetland restoration schemes. For example within the pumped drainage landscape of the Venice Lagoon (a territory mostly use for agriculture -77%) is carrying out a project aimed at developing a catchment strategy to reduce nutrient loads entering the Lagoon. Besides the main objective was taken the opportunity to reduce flood risk and develop ecological value of the riverine environment.

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