

ABSTRACT PhD thesis Iris Baart

Floodplains are among the most threatened ecosystems in the world. Due to socio-economic pressures, such as flood protection, hydropower production and navigation, the water areas and so the potential habitat areas of macrophytes have reduced enormously. The presented case study deals with the historical and potential development of macrophytes in the urban floodplain Lobau along the Danube River on the south-eastern border of the city of Vienna at river-km 1924–1907. The Lobau is part of Alluvial Zone National Park.

The analysis of the historical distribution of macrophytes in the Lobau was based on literature data and mappings since 1846, the time before the “Vienna Danube Regulation” (1869–1875). At that time the proportion of eupotamal and parapotamal water bodies was very high, consequently many pioneer species and other eupotamal/parapotamal species could exist. Due to channelization the water area in the Lobau reduced by 74% and the proportion of palaeopotamal water bodies increased from 3% (before the “Vienna Danube Regulation”) up to 65% (2004). Due to this development more than 20 pioneer species disappeared, whereas more than 30 typical palaeopotamal species appeared. For example also neophytes appeared which could have negative effects on ecosystems. Due to the lack of rejuvenation processes habitat aging and sedimentation accumulation proceed and consequently the hydrophytes are gradually displaced by helophytes and subsequently by terrestrial species. Without restoration measures the Lobau will become a terrestrial ecosystem with major implications for its aquatic biodiversity.

In the frame of the project “Optima Lobau” possible restoration management options by re-connecting the floodplain Lobau with the Danube were analysed. Macrophyte regression models, which are able to model the species diversity and abundance of macrophytes, were developed and different floodplain management options were modelled. The management options and the regression models are based on the output of a 2D hydraulic model, made by the Technical University of Vienna. Submerged water area, water velocities and water depths were calculated. The most important predictors of the macrophyte indicators were water velocity at bankfull discharge at $4000 \text{ m}^3 \text{ s}^{-1}$ (maximum water velocity) and size of shallow water areas ($<1\text{m}$ depth) at a water discharge of $3000 \text{ m}^3 \text{ s}^{-1}$. They explain the species diversity with 65% and the macrophyte abundance with 85%. The shallow water areas represent the main habitat area of macrophytes and the water velocity at bankfull discharge integrates information about environmental features such as nutrients and hydrological disturbance.

The modelling of management options has shown that a partial connection from the Lobau to the Danube could be a better solution for the existing macrophyte development compared to a complete reconnection. A complete reconnection of the remaining floodplain area in the Lobau to the Danube main channel (maximum achievable restoration goal) would cause that shallow water areas will be reduced drastically and the hydrological stress will increase. In general, pioneer plants would benefit, but the habitat conditions for many other water plant species, especially palaeopotamal species, could be less favourable. A complete reconnection could also have unintended negative effects on macrophytes like facilitating the dispersal of neophytes and exposing the floodplain to the present, altered water regime. Furthermore sediment transport has reduced during the last 200 years. A partial reconnection could be a compromise solution.

Based on my research I advise to use available historical data combined with scientifically sound investigations and models which consider the changes of the boundary conditions at larger scales (water regime, socio-economic changes in the catchment) in order to estimate possible effects of restoration measures and to maximize their success.

Keywords: macrophytes, floodplain management, restoration, modelling, reference condition