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Prediction of potential macrophyte development in response to restoration measures in an urban riverine wetland

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ABSTRACT

Wetland restoration efforts require practical models for predicting the effects of various measures on ecosystem structure and function. The present study examined the species diversity and abundance of macrophytes in relation to hydrological parameters in the *Alluvial Zone National Park* along the Austrian Danube with a main focus on the Lobau, an urban riverine wetland within the city limits of Vienna. A macrophyte regression model was developed based on the output of a 2D hydraulic model for different wetland management options. These management options describe possible rehabilitation measures by re-connecting the riverine wetland with the Danube. Stepwise multiple regressions revealed that the most important predictors of macrophyte diversity and abundance were water velocity at bankfull discharge (maximum water velocity) and size of shallow water areas (<1 m depth) during the growing season. Macrophyte abundance and diversity increased with decreasing water velocity and increasing shallow water area. These parameters integrate information about environmental features such as nutrients, light availability and hydrological disturbance for macrophytes and explained between 65 and 85% of the macrophyte distribution in an analysis. The model results enabled us to predict quantitatively the development and spatial distribution of macrophytes for different management options in this urban riverine wetland. These predictions suggest that partial reconnection could be a compromise solution at the scale of the whole riverine wetland, increasing the availability of suitable aquatic habitats and diversifying the types of existing wetland water bodies to establish potential new habitats for macrophyte species.

1. Introduction

Riverine wetlands are transition zones between land and water ecosystems. Processes such as flooding, erosion and deposition, groundwater supply and terrestrialization collectively lead to habitat heterogeneity favouring high biodiversity (Amoros et al., 2000; Wetzel, 2001). As a result, riverine wetlands tend to be key ecosystems for preserving biodiversity around the world (Tockner et al., 1998; Ward et al., 1999). Unfortunately, these riverine wetlands are also among the most threatened ecosystems in the world, with up to 95% of the original European riverine wetlands already lost (Petts et al., 1989; Tockner and Stanford, 2002). Most of the remaining riverine wetlands are restrained by anthropogenic constructions such as embankments, which impede fluvial processes and affect functional integrity (Jungwirth et al., 2002). Due to the lack of fluvial connections many riverine wetlands have turned into more static, shallow, lake-like systems (Ward et al., 1999; Schiemer et al., 2006; Hohensinner, 2008). Presently, river restoration projects aim to regain the natural fluvial dynamics with the purpose of approaching pre-regulation alluvial characteristics and enhanced connectivity (Nienhuis and Gulati, 2002; Palmer et al., 2005).

Macrophytes are characteristic features of shallow aquatic systems (Coops et al., 2002; Janauer, 2006; Feldmann and Nõges, 2007). Their presence is controlled by environmental factors such as nutrient conditions, water quality, hydrological regime and terrestrialization and thus indicates important ecosystem characteristics (Kohler, 1978b; Brock et al., 1987; Bornette et al., 1998a; Amoros et al., 2000; Jeppesen et al., 2000; Janauer, 2001; James et al., 2005). Due to the decline of areas of open water and flood distur-

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