

# PhD research in REFORM - Interactions between aquatic macrophytes and hydromorphology in rivers

## About "PhD research in REFORM"

In the newsletter items dedicated to PhD research in REFORM, PhD students introduce the topic and the initial results of their research.

## Introduction

The distribution of aquatic macrophytes strongly depends on the physical conditions of the river. Macrophytes act as ecosystem engineers, influencing flow velocity, water depth, sediment scouring and sedimentation. Furthermore, they play a vital role for other biota in river ecosystems, providing food and shelter for many macroinvertebrates and fish. Yet, only few restoration projects involve post-project monitoring of aquatic macrophytes. Therefore, there is a lack of understanding how macrophytes respond to restoration measures over time, which is essential for restoration projects to sustainably meet their aims.

## Objectives

The main goal of this research is to better understand the interactions between aquatic macrophytes and river hydromorphology with a focus on restoration. In this way, the work is meant to contribute to increase the effectiveness of river restoration. Moreover, different macrophyte management approaches will be investigated to enhance self-sustainability, increase river health and reduce maintenance costs.

## Approach

An extensive literature study has been conducted to summarise the different aspects of the interactions mentioned above, especially in restored river reaches.

To promote the added value of post-project monitoring of macrophytes in restoration projects, an analysis of macrophyte responses to different kinds of restoration was performed. The study covered 20 restored river reaches across Europe. To avoid general conclusions being restricted to the dispersal area of certain species, the focus was set on growth forms.



*Figure 1: The lowland river Spree near Mönchwinkel, Brandenburg (Germany) (Photo: Jan Köhler)*

Macrophytes displace water and increase roughness in the river, so cutting aquatic weeds lowers the water level and increases the discharge capacity. This practice is regularly performed in the German lowland river Spree as a flood prevention measure. Conducted in an extensive way, this measure constitutes a severe interference with the fragile ecosystem (see Figure 2).

In a field experiment, our aim is to detect changes in the food web via stable isotope analysis after removing the macrophytes. In this method, the ratios of stable carbon ( $^{13}\text{C}/^{12}\text{C}$ ) and nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) isotopes of organisms are determined. This allows for a clear distinction between the primary food sources (e.g. aquatic and terrestrial plants, epiphyton) because of their different isotopic signatures, which depend on the nutrient source. Heavier isotopes ( $^{13}\text{C}$  and  $^{15}\text{N}$ ) are processed more slowly than lighter ones during metabolism and therefore become enriched in the organism. As a consequence,  $^{13}\text{C}$  and  $^{15}\text{N}$  accumulate in the food chain and the isotopic signature can be used as a tracer for the position in the food web.



*Figure 2: Staff of the local water management association removing mowed aquatic macrophytes from the river Spree, Brandenburg (photo: Jan Köhler).*

Furthermore, we will quantify the limiting effects of shading by woody riparian vegetation on macrophyte growth. Aquatic vegetation mapping and light measurements in the river Spree will be conducted. Additionally, long-term data on the annual amount of macrophytes being removed from the river and on discharge being influenced by the cutting will be analysed. By combining these results with the insights gained on the shading effects of bank vegetation, we aim to demonstrate planting of riparian trees as the more environmentally sound option for macrophyte management in order to prevent floods.

### **Preliminary Results**

So far, our review has covered 170 studies from across the world, in which we found quantitative data on the environmental requirements of 176 aquatic macrophyte species. Based on this compilation and further studies describing the influence of macrophytes on their environment, we were able to generally illustrate these interactions in an easily accessible way (Figure 3).

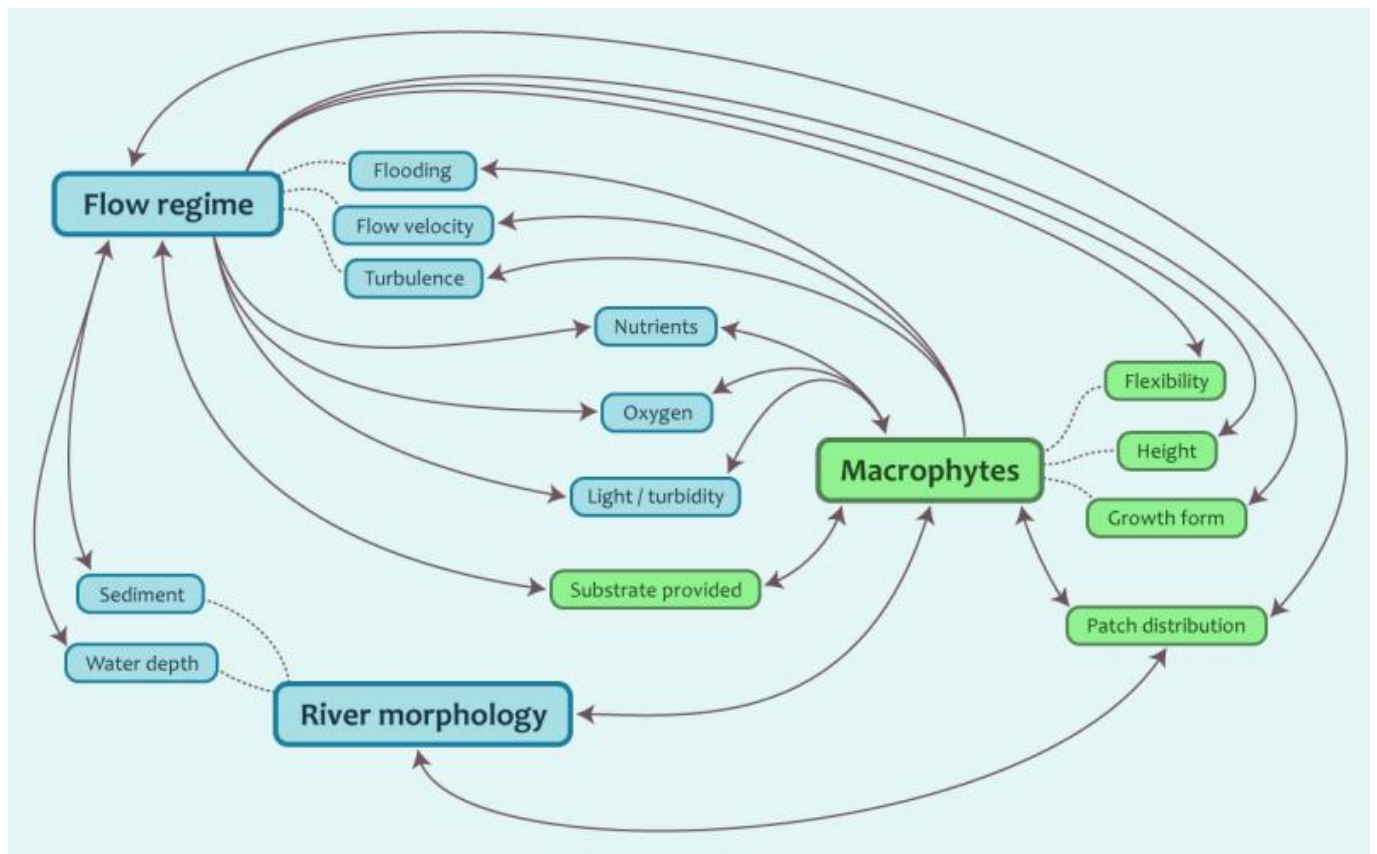


Figure 3: Outline of the interactions between aquatic macrophytes and river hydromorphology (figure: Sabine Scheunig).

Quantifying restoration effects, a higher species richness (about 92%) and a higher Shannon diversity (about 38%) of the helophyte community – emergent plants growing on the edge of water bodies where the water level fluctuates – were found in the restored reaches compared to adjacent degraded ones. This was observed especially in rivers where widening was carried out. The work also showed a correlation between these parameters and the improvement of hydromorphological variables. These results emphasise the suitability of helophytes as indicators for effective river restoration. In particular, they reflect the connectivity between the river bed and its adjacent area.

Stable isotope analysis for studying the food web in the river Spree is in its final stages. Field experiments to quantify shading impacts on macrophytes are underway.

**Further links**

REFORM Deliverable 1.3: Review on ecological response to hydromorphological degradation and restoration

REFORM Deliverable 4.3: Effects of large- and small-scale river restoration on hydromorphology and ecology

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## For further information:

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