



**Universität Stuttgart**



Department of Hydraulic Engineering  
and Water Resources Management  
Prof. Dr.-Ing. Silke Wieprecht

University of Stuttgart . Institute for Modelling Hydraulics and Environmental Systems  
Department of Hydraulic Engineering and Water Resources Management  
Pfaffenwaldring 61 . 70569 Stuttgart

Contact

PD Dr. Stefan Haun

Phone

+49 - (0)711 / 685-64691

Fax

+49 - (0)711 / 685-64746

E-mail

stefan.haun@iws.uni-stuttgart.de

Date

16.09.2023

**Please forward to appropriate candidates**

## **TOPIC: Laboratory experiments to optimise habitat diversity by reintroducing wood in rivers**

### **Advisor**

PD Dr. Stefan Haun

Department of Hydraulic Engineering and Water Resources Management

Institute for Modelling Hydraulics and Environmental Systems (IWS)

University of Stuttgart

### **Keywords**

Large wood, Nature-based solutions, Instream river training, physical model experiments

### **Introduction and background**

According to the EU-WFD (European water framework directive), more than 90% of German rivers and 60% of the rivers in the EU are in a deficient stage of ecological degradation. The two main drivers for this degradation are (1) loss of morphologic diversity and (2) loss of longitudinal, lateral and vertical connectivity. Both are closely related to the removal of wood from the rivers, which is common practice and has a long tradition in European rivers.

River restoration schemes based on reintroducing wood into the rivers have therefore become increasingly important. However, design standards and calculation schemes are largely missing and hinder an optimised and broader use of wood.

The main challenges herein are the properties of wood, that differ from standard engineering building materials. Wood and wood structures have a complex and heterogenous shape, properties of anisotropic porosity and a dynamic buoyancy due to wetting and drying processes. Predictions of their hydraulic and morphodynamic impact are thus demanding. Even more so, if the natural dynamics of a river system have to be considered that determine habitat quality



and ecological functioning. Existing literature on the hydromorphologic processes related to wood in rivers is scarce and there is an urgent need for systematic studies under controlled conditions in the laboratory. We will therefore run tests with different idealised and standardised wood types and quantify their effects on bed topography, scour and sediment deposition patterns.

### **Research goals and methods to be used**

First, the Ph.D. candidate is responsible for reviewing the state-of-the-art literature on wood in rivers, on the processes and key features that wood provides for aquatic habitats and the related ecological functions. Further, reviewing the classic engineering literature on bridge pier scour and tunnelling scour is a prerequisite for understanding the more complex wood cases.

The candidate will conduct own flume experiments with different wood structures and under different flow configurations. Abstracting the complex and heterogenous properties of wood and transferring them into a physical scale model will be a central part of the research – and to some extent - also involve field studies and observations. Measurements in the lab will include flow quantification (velocity profiles, turbulence quantities), flow visualisation techniques and time-resolving surveys of the bed topography (cross-sections, analyses of scour evolution).

Besides the required publications in peer-reviewed journals, the findings will be included in a practitioner's guideline for the use of wood in restoration (DWA-Merkblatt). The collected data will be added to our wood scour database with planned public access at a later stage.

### **Research environment**

The PhD candidate will conduct experiments in the hydraulic laboratory at IWS. Besides, the student will become part of an interdisciplinary working group consisting of post-docs and doctoral students who conduct research on morphological processes in rivers.

### **Prerequisites**

Good knowledge in hydraulics, turbulent flows and sediment transport is required, as well as commitment to improve the ecology of rivers.

English language skills sufficient for scientific writing, reading and speaking.

### **Contact for research questions**

PD Dr. Stefan Haun, University of Stuttgart, [stefan.haun@iws.uni-stuttgart.de](mailto:stefan.haun@iws.uni-stuttgart.de)

### **Contact for administrative questions (e.g., on the admission process)**

Dr. Gabriele Hartmann, University of Stuttgart, [gabriele.hartmann@f02.uni-stuttgart.de](mailto:gabriele.hartmann@f02.uni-stuttgart.de)