HAZARD AND RISK ASSESSMENT (ANALYSIS, EVALUATION)

Large wood management in rivers — a practice-oriented research project in Switzerland

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BACKGROUND:
Large wood (LW) in rivers plays a very important role in supporting the biodiversity and ecosystem functioning, both directly and indirectly, influencing the form and sedimentary structure of rivers and floodplains, affecting sediment sorting and providing a wide variety of habitats, as well as a food source for many organisms. Despite the positive contributions of LW to river ecosystems, LW may also induce risks for human populations. Recent floods in the Swiss Prealps, Alps and other mountain regions have highlighted some of these effects, particularly at critical sections such as bridges and weirs. In-channel wood may reduce the cross-sectional area due to blockage which in turn trigger a quick succession of backwater effects with bed aggradation, channel avulsion and local scouring processes that ultimately might cause embankment/bridge/weir collapse, floodplain inundations and overbank sedimentation. As a result, the flooded areas may be different from those predicted without the consideration of LW and can cause damage to infrastructures or aggravate pier scour. In addition, LW loads can also fill reservoirs and block spill-ways. Therefore, the challenge of better in-stream wood management is to maintain the equilibrium of the good ecological and hydromorphological condition of rivers, and at the same time analyse and manage the potential risks. The main emphasis today must be put on reducing the damage potential along water courses, and this requires an integrated management approach. This is the aim of the project presented in this work, and supported by the Swiss Federal Office for the Environment (FOEN).

GOALS AND PROJECT STRUCTURE:
The purpose of this project, which has a duration of 3.5 years (2015 - 2018), is to develop the knowledge and methods to analyse LW dynamics in Swiss rivers. The main questions to be investigated in the planned activities are:
– The recruitment processes and source areas of LW: the main processes responsible for controlling the amount of LW within a stream reach will be identified, exploring driving variables (climate, forest stand and morphological factors) and input processes (landslides, debris flows, snow avalanches, bank erosion).
– The entrainment, transport and deposition of LW in rivers: to understand the processes involved in the LW dynamics, how LW evolves when transported (breakage), travel distance and to recognise and predict potential depositional areas.
– LW related hazards and risks: identification of critical sections and potential hazards will be carried out, together with the analysis of potential impacts (erosion, sedimentation, flooding…).

The following procedure is illustrated for the analysis of LW on an integrated and holistic concept covering watershed, forest and riparian forest management, maintenance of the water courses and non-structural and administrative measures (Figure 1).

The project organization is multidisciplinary, and was designed to strengthen the collaboration between partners, with strong expertise in their respective fields. Therefore, different approaches will be used to understand, quantify and model the processes involved in LW dynamics in river basins. To do this, the most advanced techniques will be combined: (i) empirical and statistical methods; (ii) GIS, ground imagery and remote sensing analysis; (iii) field surveys, including dating and mapping of wood deposits, river hydraulics, and forest analysis; (iv) physical experiments, using innovative experimental models; and (v) numerical modelling.
PROJECT IMPACTS AND EXPECTED RESULTS:
Results will improve the understanding about the geomorphic and ecological processes associated with LW. Knowing where and how much LW may be recruited will help to identify the relative importance of different recruitment processes. At the river reach scale the main factors controlling LW transport and deposition will provide insights regarding the volume of transferred LW through a system, how LW is mobilised and where is deposited. The analysis of potential hazards due to blockage, allows identifying critical sections. When LW interacts with any critical section, administrative measures are needed.
This project will also contribute to the development of a federal management strategy and will help to evaluate and modify established protection concepts.

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Figure 1. Schematic representation of the research project concept

KEYWORDS
flood hazard; bank erosion; woody debris; driftwood

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