

Artificial flooding to restore river ecosystems

The dynamics of rivers used for hydropower generation are severely restricted – with consequences for the habitats of numerous species. Artificial flooding can help restore these ecosystems. Researchers from the aquatic research institute Eawag and the Zurich University of Applied Sciences (ZHAW) are investigating such interventions on two Swiss rivers. The results show that regular floods are necessary to achieve long-term effects.



Drone image of the Rossens dam on Lake Gruyère during the artificial flood in 2016: A controlled water release inundates the residual-flow reach downstream of the dam. (Photo: Michael Döring, ZHAW)

Natural rivers and floodplains are highly dynamic ecosystems that are constantly changing, driven in particular by changing flows and the transport and redistribution of rocks and other solid materials - known as sediments - along the riverbed. Dams and water abstraction can significantly alter flow and transport and redistribution of sediment in residual-flow reaches downstream. As a result, important habitats, for example for gravel-spawning fish such as trout, can be lost. Floodplains are also of central importance for biodiversity, providing habitat for up to 84% of native species at least at some point in their life cycle. Without regular floods, these ecosystems can gradually decline.

Mimicking natural river dynamics with artificial flooding

Artificial floods aim to restore some of these lost dynamics. During these events, hydropower plants deliberately release larger volumes of water, temporarily inundating the riverbed and adjacent areas. This is intended to restore river and floodplain habitats for aquatic organisms and mitigate the effects of highly reduced flow dynamics and disrupted sediment transport.

Researchers from Eawag and ZHAW are investigating how artificial flooding can help restore river ecosystems in two projects: on the Saane, a highly regulated residual-flow reach downstream of the Rossens dam, and on the Spöl, a mountain stream in the Swiss National Park. The results show that artificial flooding can, to some extent, mimic the natural dynamics of rivers and floodplains even in residual-flow reaches, and can improve conditions for aquatic organisms. However, it is not enough simply to trigger a flood, each event must also be adapted to local conditions. Larger water releases are not necessarily more effective: floods that are too strong can cause unwanted erosion. This is particularly important in rivers with limited sediment supply, such as the Saane, where artificial floods need to be combined with targeted sediment replenishment.



*Effects of controlled artificial flooding on the Saane and Spöl rivers.
Photos: Michael Döring [1,2], Eawag [3]*

Regular flooding needed for long-term effects

The comparison of the two projects on the Saane and Spöl rivers illustrates this clearly. On the Saane, artificial floods have been carried out irregularly since 2016. While these events can trigger substantial ecological and morphological changes in the short term, long-term monitoring shows that the positive effects diminish after longer periods without flooding and the river gradually returns to its previous state. The situation is different on the Spöl, where artificial floods were released up to three times a year between 2000 and 2016. Over many years, this helped maintain the river in a dynamic state.

“A single flood can have a major short-term impact. For long-term restoration, however, regular, repeated events adapted to the characteristics of the individual river are needed,” says Michael Döring, researcher at ZHAW and Eawag, responsible for the two projects. “We now want to establish these regular floods on the Saane in the long term as well.”

On 24 September, the Saane below the Rossens dam on Lake Gruyère will once again be flooded. The targeted release of additional water will be coordinated by the hydropower producer Groupe E and is funded by the Swiss Federal Office for the Environment as a measure to support the ecological restoration of hydropower-affected rivers.



Drone images of the Saane River before and after the 2023 floods. They clearly show the redistribution of sediment and the formation of open gravel areas typical of natural rivers and floodplains. (Photos: Michael Döring, ZHAW)