# Restoration of flood-maintained ecosystems

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ABSTRACT: The ECOPEAK project was initiated in 2019 as a part of the research and innovation program Hållbar Vattenkraft (Sustainable hydropower) – HåVa at the Swedish Energy Agency. The purpose of the project is to develop management methods to restore riparian communities in Natura 2000 areas in rivers used for hydropower production. In the project we analyse the potential for reintroducing short high-flow events mimicking seasonal floods to enhance the processes creating and rejuvenating riparian habitats with high natural values along regulated rivers. We evaluate the efficiency of different peak-flow scenarios to create habitat using hydraulic modelling based on empirical flow-ecology relationships.

We have focused on riparian areas in the middle parts of Klarälven and the lower parts of Dalälven in Sweden as these reaches have some of the highest riparian natural values in Sweden. At the same time, they are affected by large scale hydropower and are important components of the Swedish energy system. Typical flow alterations in these rivers consists of diminished or lacking spring floods, and higher winter flows compared to unregulated conditions. There is also impact from hydropeaking in these reaches. In Klarälven, the high natural values are linked both to flood dynamics and to erosion and sedimentation dynamics in the meandering river channel. The red-listed *Salix daphnoides* and *S. triandra* are signature species that grow on the sandy point bars. However, the point bars have declined in extent due to regulation. The Lower Dalälven has some of the highest natural values in Sweden in terms of riparian ecosystems. With its diversity of habitats listed in the Species and Habitats Directive, these are unique areas with many red-listed species. Due to reduced high-flow peaks, species such as Norway spruce may out-compete species associated with the floodplain forest, leading to narrower riparian areas with lower species richness. These habitats are thus dependent on recurring floods, but it is not clear how frequent and long these floods need to be.

In order to better understand the relationship between flooding regime and floodplain vegetation we explore hydraulic conditions and construct probability curves describing preferred occurrence of riparian species according to flooding regime. Additionally, we create response curves describing survival and growth for tree species present in the riparian zone. Further, we make predictions of the unregulated extent of different vegetation belts (aquatic, graminoid, *Salix,* and riparian forest) based on vegetation belt distribution data from the unregulated Vindel River together with modeled unregulated flow regime. We compare the current extent of the different vegetation belts to pre-regulation extents in order to make deficit analyses for the habitat types. Finally, we determine the frequency and duration of inundation needed to create different vegetation belts associated with high riparian natural values, and to ensure the presence of specific plant species of high conservation value.