Mitigating hydropeaking impacts and enhancing fish habitat by hydromorphological adaptions of the river bathymetry

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ABSTRACT: Dale power plant, located in Western Norway, was established in 1928. The outlet is approx. 2.8 km upstream the rivermouth in the Dale River. Salmon and sea trout live in the lower 4.8 km of the river. The power plant determines the flow of water downstream the outlet. The minimum flow here varies between 3 and 5 m^3/s and the powerplant has a maximum flow capacity of 44 m^3/s. Hydropeaking is applied during large parts of the year. The water flow from the outlet may therefore vary between 5 m^3/s and 44 m^3/s within 1-2 hours.

In today's energy system ability to balance the system is an important condition for security of supply and stability in the grid. With high shares of intermittent generation like wind power and solar PV the need for regulating power is increasing. This creates disadvantages linked to water level changes downstream of powerplants with outlets in rivers. In the Dale River, a rapid change in water flow can lead to the stranding of fry and fish. To compensate the disadvantages of rapid water level changes, some measures have been taken. Still, we see that this is might not sufficient.

To mitigate the environmental impacts of hydropeaking, both flow (direct measures) and habitat-related (indirect) measures have been implemented. The velocity of flow changes has been reduced by increasing the time intervals between turbine flow steps. Habitat adjustments were made in test sites to minimize dewatering areas, while maintaining high habitat quality.

In 2023 a new approach has been developed, wherein hydromorphological adaption of the river bathymetry has been applied to the entire river stretch downstream of the power plant. The design and the assessment of the mitigation was done based on detailed RTK-UAV measurements, 2D hydraulic modeling, habitat modeling, and the identification of natural river morphology types, which allowed to develop bathymetric adjustments that minimize the dewatering area and enhance habitat quality. For habitat modelling the novel HEM-Peak model was applied which enables (i) the quantification of hydraulic stable habitats in terms of base and peak flow and (ii) the quantification of the dewatering area as a proxy for the stranding risk. The main measures used were lowering and increasing of river sediment levels, restoration of diamictic plane bed reaches, restoration of side channels, spawning gravel augmentation, ripping of clogged sediments and ground sill removal. Impoundment of river stretches to minimize dewatering was completely avoided. The modelling results predict both beneficial aspects, the increase in hydraulic stable habitats and the decrease in the magnitude of the dewatering areas.

The presentation will describe the experience with the implemented mitigation measures and introduce the concept of adjusting the entire river's bathymetry based on natural river morphology types, minimizing dewatering areas and enhancing habitat quality.