

Electrified fish guidance racks - scaling and operational aspects

Downstream migrating fish in rivers must pass multiple run-of-river hydropower plants (HPPs). Fish passage through turbines or spillways of HPPs can result in high injury and mortality rates, which may lead to a decline in fish populations. The revised Swiss Waters Protection Act (WPA) introduced in 2011 aims at restoring water bodies and eliminating negative impacts of HPPs as to fish migration by 2030. VAW is developing an electrified fish protection structure which can be retrofitted at existing bar racks, therefore increasing fish protection at relatively low cost. Furthermore, possibilities to electrify horizontal and vertical bar racks to increase protection have been explored. Through electrification with a low voltage pulsed direct current, an electric field is generated in front of the rack which incites an avoidance reaction in approaching fish. The results from live fish test with eel (Fig. 1) are promising, because high protection efficiencies have been observed.



Fig. 1: Eel reacting to the electric field in the laboratory flume at VAW

In this thesis, aspects of scaling electrified fish racks from laboratory to prototype conditions will be analyzed and numerically investigated for hydropower plants of different size. HPPs with respective electrified bar racks will be numerically modelled using the software Comsol. The effect of environmental and hydraulic parameters such as temperature, discharge, water conductivity and driftwood/debris accumulation on the power consumption and distribution of the electric field will be evaluated. The thesis consists of theoretical work and numerical simulations calibrated with existing laboratory measurements.

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NB: Thesis can be written in German or English.