Other Conference Item

Fishfriendly Innovative Technologies for hydropower (FIThydro) Swiss case studies HPP Bannwil & HPP Schiffmühle

Author(s):
Meister, Julian; Beck, Claudia; Fuchs, Helge; Albayrak, Ismail; Boes, Robert M.

Publication Date:
2018-04-18

Permanent Link:
https://doi.org/10.3929/ethz-b-000259524

Rights / License:
In Copyright - Non-Commercial Use Permitted
Fishfriendly Innovative Technologies for hydropower (FIThydro)
Swiss case studies HPP Bannwil & HPP Schiffmühle

J. Meister, C. Beck, H. Fuchs, I. Albayrak, R. Boes
Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zürich, Switzerland

Introduction
Two case studies at run-of-river hydropower plants (HPPs) in Switzerland are conducted within the scope of the interdisciplinary “Fishfriendly Innovative Technologies for Hydropower (FIThydro)” project which is funded by the Horizon 2020 framework program of the European Union for research and innovation. The investigations focus on the velocity field (ADCP measurements and numerical modeling), the monitoring of fish downstream migration, and the sediment transport.

Run-of-river hydropower plant Bannwil
The run-of-river HPP Bannwil is a block-unit power plant at the River Aare in Switzerland (Fig. 1) with a design discharge of 450 m³/s. The gross head amounts to 5.5 – 8.5 m depending on up- and downstream water levels. The three 4.35 m diameter bulb turbines have an installed capacity of 28.5 MW, resulting in an average annual production of 150 GWh. The downstream Aare reach features nine run-of-river HPPs and two nuclear power plants with water abstractions for cooling.

Field measurements within FIThydro
Within the FIThydro project, 250 fish will be equipped with radio-telemetric tags. Their migration routes in the vicinity of the HPP will be observed for 2 years. The fish behaviour will be further observed with sonar camera systems at specific locations (e.g. in front of the intake rack).

To examine operational measures for a safe downstream migration, VAW will conduct ADCP measurements of the velocity field and will set up a 3D numerical model to compare different operational alternatives (Fig. 2). Furthermore, the installation of a fish guidance structure with vertical bars in combination with an adjacent bypass system will be considered.

Restoration targets
The target fish species in that Aare reach are salmon and barbel. For upstream migration, a fish pass is installed which has to be renewed until 2020. Downstream migrating fish are routed through the turbines or over the weir in case of flood events. Fish protection and bypass systems have to be installed until 2025.

Field measurements within FIThydro
The residual flow HPP Schiffmühle is equipped with a natural fishway and a vertical slot fish pass for upstream migration. In 2013 it was equipped with a horizontal bar rack bypass system for fish downstream passage (Fig. 3b).

Fig. 1: Head water of block-unit HPP Bannwil with the turbine intakes in the background (Photo: VAW)

Fig. 2: ADCP measurements downstream of HPP Bannwil (Photo: VAW)

Field measurements and numerical modeling
The velocity field in front of the residual flow HPP Schiffmühle will be measured with an ADCP. More than 1000 individual fish will be marked with PIT-tags to monitor their migration. To track their swimming paths, all upstream and downstream migration corridors are equipped with RFID antennas. To quantify the sediment balance, the bed load transport in the vortex tube connecting the headrace channel of the main HPP with the residual flow channel will be monitored. For the residual flow reach, the sediment properties will be determined and the flow conditions and aquatic habitats will be modeled numerically.

Partners:

Fig. 3: (a) Vortex tube connecting the headrace channel with the residual flow reach (Photo: VAW)
(b) Horizontal bar rack for fish protection (Photo: VAW)