

Swiss study for solutions for large dams – fish behavior and guiding efficiency of bar racks and louvers for fishes during downstream migration at hydropower facilities

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Swiss rivers are used intensively for hydropower production and contribute 60 % to the electricity supply. The new national water law and fisheries legislation require the re-establishment of fish migration. Until 2030 all hydropower facilities have to provide a safe downstream migration corridor. However for the protection of downstream migration for fishes almost no migration facilities yet exist. A few European countries have used technological solutions to facilitate downstream migration at small hydropower plants. However, no analogous solutions exist for larger European hydropower dams.

In an artificial laboratory flume we tested guidance efficiency of selected European fish species (barbell, brown trout, eel, grayling and spirlin) using bar racks and louvers angled at 30 and 15 degree to the approaching flow (related water velocities 0.3-0.9 m/s). The bar spacings were 5 and 11 cm. The tested fishes were caught from wild river populations using electrofishing techniques. A total of 34 different configurations were evaluated. For selected experiments we additionally used a bottom overlay to test the improvement of guiding efficiency. Video recording was used to document the experiments and fish behavior. In our experiments the main angle of the guiding array (15 or 30 degree) did not have a significant effect on the guiding efficiency. The increase in flow velocity did not affect successful bypass passage (with the exception of spirlin). The guiding efficiency was: higher for bar racks than for louvers (tested with barbel and spirlin), higher for bar racks and louvers with clear spacings of 5 cm (compared to 11 cm), and finally considerably higher with a bottom overlay, notably for grayling. Louvers did not generally show sufficient guiding efficiency, and fish often swam in the direction of the turbines. The laboratory study showed that angled bar racks have a striking potential for diverting fish species away from turbine intakes. The bar rack with 5 cm clear spacing produced good results and guided fishes safely into the bypass. In any case, additional lab and field studies are needed and more native fish species have to be tested. Experiments at a pilot hydropower plant are highly desirable.