An application of physical habitat modelling to quantify ecological flow for the Rheinau hydropower plant, River Rhine

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With 15 figures and 3 tables in the text

Abstract: The meander of the River Rhine at the Swiss-German hydropower plant Rheinau suffers from residual flow (5 m³/s vs. 372 m³/s mean flow). As a consequence, fish and benthic communities have shifted from lotic to lentic, and ubiquitous species are more abundant. The simulation model CASiMiR, linking hydraulic and morphological conditions (water depth, flow velocity, near-bottom hydraulic forces) with ecological requirements of fish and benthos, was applied to assess habitat suitability for lotic species. Various scenarios of discharge and changes in the operation of two additional weirs located within the residual water stretch were considered. Model calculations showed that good quality habitats can be achieved either by significantly increasing residual flow and unchanged weir position (90–130 m³/s) or by lowering the weirs and moderately increasing discharge (20–70 m³/s). Seasonal variation in discharge and additional ecmorphological restoration are further options to optimize the living conditions for aquatic fauna. The suggested technical operation of the weirs allows an additional 60–70 m³/s to the turbines without lowering the habitat availability for fish indicator species. Hence, it can reduce the loss of energy production from about 30 to 6 % (other feasible measures such as additional turbines using the provided residual discharge are not implied). In conclusion, such hydraulic habitat simulations can quantify the ecological impacts of technical alternatives and enable an objective, appropriate balance of ecological and economic benefits. Therefore, this kind of investigation may mitigate the controversy among stakeholders.

Key words: Ecohydraulic modelling, hydropower, residual water, benthos, fish, aquatic habitat, hydraulic-habitat-suitability-index, weighted usable area.

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