EGU21-13319, updated on 12 Jun 2021
https://doi.org/10.5194/egusphere-egu21-13319
EGU General Assembly 2021

Modeling shelter abundance for juvenile Atlantic salmon in a residual flow reach of a hydro power plant using SSIIM 2

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Nowadays, the aquatic biodiversity is highly under pressure due to anthropogenic changes of the rivers such hydraulic structures changing the diversity of flow and aquatic fauna as well as sediment continuity. This can have severe consequences on the fish population in the river reach. Fish are strongly depending on a certain substrate composition throughout all their life stages. Juveniles for example are depending on a certain availability of shelter in the substrate in order to survive this stage.

Therefore, we investigate the effects of changes in the sediment composition at a hydropower plant in Switzerland on the availability of potential shelter for juvenile fish. By utilizing the observed correlation between parameters describing the fine tail of a riverbed's grain size distribution and shelter abundance for juvenile Atlantic salmon, we predict the available shelter in a river reach by using a 3D hydrodynamic numerical model directly coupled to a morphodynamic model. The initial substrate composition was assumed to be spatially uniform, its parameters based on a grain size distribution curve derived from collected sediment samples.

This model can now be used for habitat improvement scenario modeling. Based on the assumption that a specific mixture of sediment coming from upstream travelling through the river reach will positively influence the potential shelter availability, different scenarios can be investigated. The baseline for comparison was the simulation of the bed changes without any sediment supply from upstream. The baseline discharge was set to 100 m^3 /s and was applied for 24 hours. The resulting bed changes create a map of the potential shelter availability of this grain size mixture. Then, two scenarios with sediment inflow from the upstream boundary were simulated. One coarse and one fine mixture of sediment were chosen as inputs, with the goal of investigating their impact on shelter abundance. The former designed to have a positive effect while the latter expected to reduce interstitial voids in the substrate and have a negative effect on available shelter.

The investigation is conducted as part of the EU Horizon 2020 funded project FIThydro (funded under 727830)