NUMERICAL MODELLING AS A PREDICTIVE TOOL ON HYDROPEAKINGS' INFLUENCE ON DOWNSTREAM ECOSYSTEMS

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In the coming years the operating conditions of hydropower plants are expected to change to work more in tandem with intermittent power production such as wind- and solar-power. It is expected that more hydropeaking events, i.e. rapid flow fluctuations, will occur throughout the day. It is well established that hydropower dams negatively affect the ecosystems; dams block upstream fish migration as well as changing the upstream environment by creating reservoirs. Additionally, the downstream reach is affected by rapid transient phenomena such as dewatering of beaches, entrapment of fish and flushing. Numerical modelling allows us to gain insight into how new operating conditions affect inflow parameters in the reach downstream. Variables relevant to aquatic ecosystems (i.e. flow velocities, depth and bottom shear stress) can be readily extracted from such models.

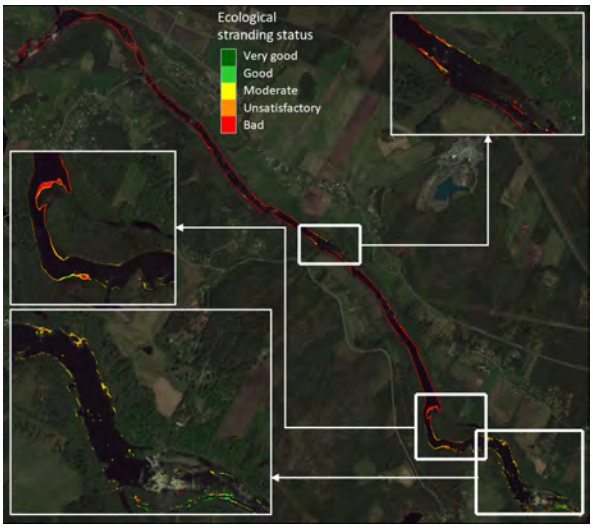

Figure 1: Stranding status index for European grayling and brown trout fry at a closing time of 1 min [1].

The risk of stranding for salmonids is dependent on the species, life stage and time of the year. In Figure 1, the stranding status for European grayling (*Thymallus thymallus*) and brown trout (*Salmo trutta*) fry has been modeled for a fast downramping rate (one minute). The suitability of spawning sites for salmonids can be investigated by looking at different ranges of inflow variables. A model using ranges of flow velocity and depth has been visualized in Figure 2, using two steady state cases for Atlantic salmon (*Salmo salar*).

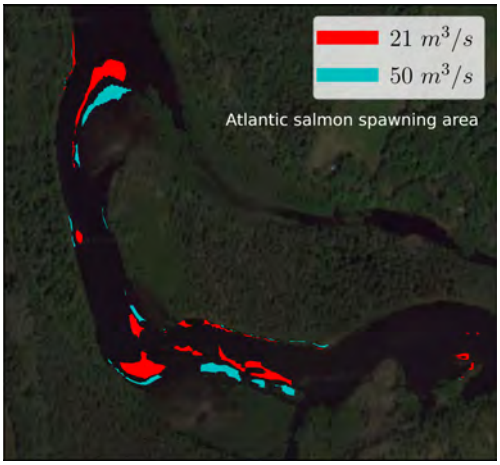

Figure 2: Example of potential spawning area for Atlantic salmon at two different flows [2].

In addition to flow velocities and water depth, salmonids also look for substrates (gravel) for laying their eggs. If these gravel beds become exposed to the atmosphere when the discharge is changed, the eggs run the risk of dying. Furthermore, a potential spawning area might not be suitable at another discharge. Through hydraulic modelling it is possible to predict the dynamics of the velocities and depth in the reach. Hence, it is possible to investigate suitable locations for spawning (e.g. where depth and velocity is within the recommended range for many different flows). Recent research suggests that effects on spawning habitats due to hydropeaking reduces as a function of the distance downstream of the power plant [3].

References

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