

Impact of weirs and hydropower regulation on brown trout, invertebrates and people in an inland river; expanding the concept of environmental design

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ABSTRACT: In this study we investigate the impact of weirs on the local brown trout population and benthic invertebrates in a regulated inland river using the principles of environmental design, originally developed for regulated salmon rivers. The investigated stretch of river Nea, is approximately 33 km and is characterized by 32 weirs. The hydrological analyses show that the water flow is significantly reduced after regulation, both during summer and winter. Historically, River Nea has been an important spawning and recruitment river for the large brown population in Lake Selbusjøen. However, because of the large number of weirs and reduced waterflow the status for the brown trout and the ecosystem has been questioned

We studied how the numerous weirs in the river impact the local brown trout population and benthic invertebrates and have identified bottlenecks for the population. Using both traditional methods and modern tools such as remote sensing drones, green lidar, as well as genetic methods such as environmental DNA and barcoding to accomplish this. The leisure use of River Nea and nearby areas by local inhabitants and tourists has been studied, as well as how potential mitigation measures are perceived. Our results show that the spawning stock of the brown trout population is very small, inbred and fragmented probably due to migration barriers in the form of weirs that limit the migration and gene flow within the population. The benthic invertebrate biodiversity in total is reduced, compared to what we expect and number of species is reduced in weir pools, compared to rapids. Surveys show that River Nea is of great importance to locals and tourists and that weirs are important for peoples perception of the landscape. However, people are positive to measures that improves the environmental conditions for brown trout and invertebrates.

The bottlenecks for the brown trout population and invertebrates in the investigated stretch are linked to both hydrological and habitat-related conditions. The weirs have been identified as a strong bottleneck and to mitigate this challenge we have suggest some mitigation measures and modification of the weirs. We suggest to modify design of weirs to re-establish connectivity, such as migration routes for spawning salmon, re-establish un-used spawning areas and maintain deeper areas for overwintering. As a main measure to achieve these requirements, we propose that the weirs be partially opened by means of ramps with migration channels.