Investigation of canoeing impact on fish by use of habitat modeling

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Recreational activities in flowing waters are gaining importance in many countries and canoeing has become more and more popular in recent years. In particular, morphologically attractive and easily accessible river sections that can be navigated without specific skills experience growing anthropogenic impact. Climate change and the corresponding more frequent dry summers within the last decades increase the pressure on river ecosystems since low water levels intensify the effects of navigation. The Wiesent River in Bavaria is one of the most canoe frequented rivers in South-Germany but it is simultaneously one of the flowing waters with the best-preserved European grayling (Thymallus thymallus) and brown trout (Salmo trutta m. fario) populations in the region.

To quantify the impact of canoeing and to find regulations ensuring a recreational use of the river that complies with the ecological requirements a multicomponent study has been performed. It integrates fish monitoring and habitat mapping, hydrodynamic modelling and fish habitat investigations of several representative reaches and forms a basis for ecologically sound management recommendations.

Possible boat (paddle) collisions with the river bottom depending on the river discharge were investigated using a combination of hydrodynamic simulations with a specific boat-agent approach. Derived canoe paths were overlayed with the fish habitat modelling results performed with the software system CASiMiR. Information on the disturbance intensity gained through the fish observations with underwater camera together with literature research have been used to derive habitat suitability reduction factors due to canoeing.

Results show that Fulton’s condition factor for fish in the river sections with permitted canoeing was significantly lower than in the reaches prohibited for canoeing. The underwater camera observations confirmed a significant disturbance on feeding behavior of wild fish that becomes more pronounced the closer the boats are passing by. The risk of boats touching the ground and causing potential damages in several ecologically valuable riffle sections is correlated to river discharge. Additionally, differences in disturbance probability were detected between unexperienced and experienced canoers. The modelled habitat reduction due to boat traffic indicates that impacts significantly increase for flow rates below the mean low flow and are closely related to river morphology.

Recommendations integrate inter alia flow dependent regulations, temporal regulations with seasonal and daily aspects, a maximum number of disturbances, as well as suggestions for location and extension of bypass sections.