How a barrage and spur dikes affect Megalobrama terminalis spawning sites at the Beijiang River (China)

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Water conservancy projects may result in considerable economic and social benefits, though there is widespread concern about how their impact on aquatic ecosystems. This is why we assess the impacts of the construction of a barrage and spur dikes in a reach of the Beijiang River between the Feilaixia and the Qingyuan on fish habitat conditions. A habitat suitability model was established by coupling a two-dimensional hydrodynamic model with habitat suitability curves. The coupled model was then used to simulate the spawning sites of Megalobrama terminalis, calculate the usable habitat area, identify the spatial distribution of suitable spawning ground in the river reach, and analyze the habitat quality and hydraulic habitat diversity. A range of scenarios were simulated with spur dikes at different elevations. Thus, we provide insights into how the barrage and spur dikes affected fish habitat conditions. The results show that the barrage negatively impacted fish habitats, and caused the usable habitat area to decrease by 35.5% in average. The high-quality habitat area and the hydraulic habitat diversity decreased because of the barrage. The spur dikes had positive effects and increased the habitat area by 13.9% in average. In addition, spur dikes increased the high-quality habitat area and enhanced the hydraulic habitat diversity. The lateral discontinuity of spur dikes (PA = 13.9%) had less impact on the fish habitat than the longitudinal discontinuity impact of the barrage construction (PA = −35.5%). The spur dikes and a barrage (PA = 21.94 %) had a more significant improvement effect on the habitat conditions than the spur dikes without a barrage (PA = 5.84 %). The barrage and spur dikes in combination resulted in better outcomes regarding habitat conditions than spur dikes alone, and the spur dikes reduce the ecological stress caused by the barrage. Non-submerged spur dikes resulted in the best improvement of hydraulic habitat conditions. The novel insights from this study can serve as a reference for engineers and scientists who are considering similar river regulation and ecological restoration initiatives.