2D hydrodynamic modeling for fish habitat assessment of two competing freshwater fish in the Yagawa River

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Small streams can provide important instream habitats for freshwater ecosystems such as fish and macroinvertebrates. Appropriate river management methods vary from river to river, and it is therefore important to understand the spatiotemporal characteristic of a target river. In this study, the authors conducted 2D hydrodynamic modelling using the iRIC software based on field surveys in a spring-fed stream in Tokyo, Japan. A series of physical habitat measurement including bed elevation, water depth, water velocity, substrates, percent vegetation coverage, etc., was conducted in a 300-m reach of the Yagawa river. Fish habitat suitability for Nipponocypris temminckii, and Lefua echigonia was assessed considering water depth and velocity using the habitat suitability index (HIS) approach. As a result, the simulated water level showed a good agreement with observed one (RMSE=0.0414). However, the simulated water velocity appeared to show an error of up to 0.3 m/s which requires further investigation for improvement. Habitat suitability distribution in the target reach changed with seasonal flow dynamics. The result helps to understand the seasonal dynamics of the fish habitat that can be used for a deeper understanding of population dynamics in the river. However, there are some limitations in this study. Since we considered only the depth and velocity for habitat assessment in this study, it is necessary to consider other factors such as substrate and vegetation. In addition, our 2D hydrodynamic model showed underestimation specifically for depth and thus the actual habitat suitability may be overestimated. Further investigation is necessary to improve model performance of the hydrodynamic model.