

Synthesis of Doctoral Dissertation
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River habitat modeling and evaluation for the whole macroinvertebrate community

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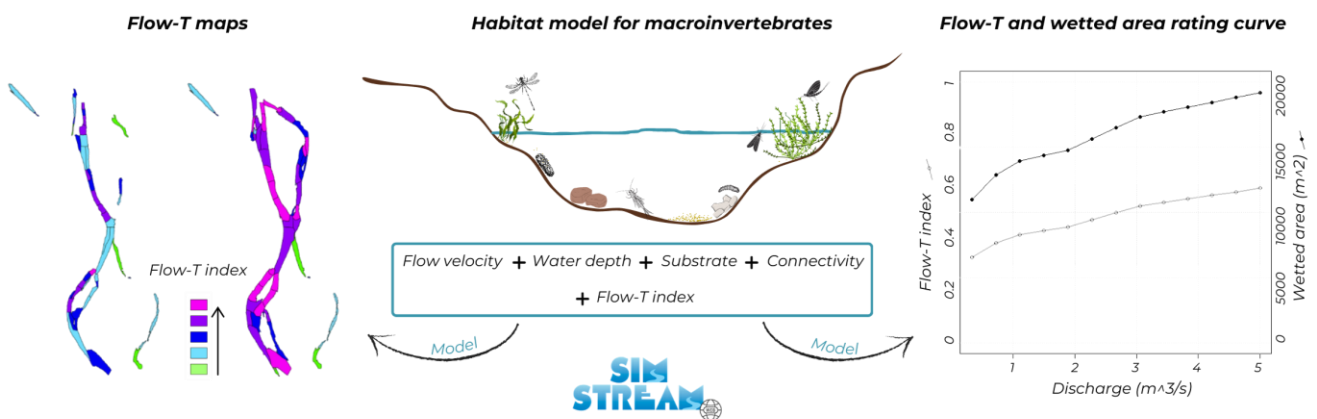
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This thesis is organized into three main parts.

Part 1, encompassing Chapters 1 and 2, introduces the theoretical and methodological framework of the study. Chapter 1 evaluates the effectiveness of mesoscale habitat modeling for predicting macroinvertebrate community structure in a braided reach of the Trebbia River (Northern Italy). By analyzing the influence of microhabitat, mesohabitat, and spatial position, results show that mesohabitats are strong predictors, supporting the transferability and applicability of mesoscale models in similar river systems. Chapter 2 presents the recently developed QGIS plugin MapStream 3.0, for the field delineation and description of Geomorphic Units (GUs), which represent the mesohabitats occupied by the macroinvertebrate communities. The tool is based on the Geomorphic Unit Survey and Classification System (GUS) and allows for data acquisition and formatting as required by the SimStream-Web service for MesoHABSIM applications.



Part 2, consisting of Chapters 3 and 4, focuses on the development, testing, and validation of a meso-scale habitat model for river macroinvertebrate communities. Chapter 3 details the modeling approach, which predicts the macroinvertebrate response to flow alterations using a trait-based index (namely Flow-T) and the machine learning technique Random Forest. Chapter 4 expands the analysis by testing and validating the model across different river systems and morphologies, refining the predictor set and improving the model transferability. The validation results were satisfactory and support the application of the MesoHABSIM methodology to the macroinvertebrate community. The presented approach can be therefore considered a robust framework for habitat evaluation and ecological flow assessments, integrating standard analytical approaches that are typically applied exclusively to fish fauna.



Part 3, presented in Chapter 5, explores the application of the Flow-T index in a different geographic and ecological context. Using long-term data from Catalan rivers (Northern Spain), collected between 1994 and 2022, this section assesses the sensitivity of the index to hydromorphological variables, demonstrating its potential use in ecological assessments.

